THE GECKOS (*SPHAERODACTYLUS*) OF THE SOUTHERN BAHAMA ISLANDS

Albert Schwartz[1]

The geckos of the genus *Sphaerodactylus* are well represented in the Bahama Islands. Recent reviews of two Bahamian species, *Sphaerodactylus notatus* Baird (Schwartz, 1966) and *Sphaerodactylus decoratus* Garman (Thomas and Schwartz, 1966), have attempted to clarify the variation and affinities of these two taxa. In addition, *S. inaguae* Noble and Klingel from the southern Bahama island of Great Inagua has been discussed in relation to the more northern *S. notatus* (Schwartz, 1966). From the balance of the Bahamian archipelago the following species have been named or reported: *S. anthracinus* Cope (reported from Andros and New Providence; Schwartz, 1961), *S. corticolus* Garman (described from Rum Cay and later reported from San Salvador, and erroneously from New Providence; Barbour, 1921:250), *S. mariguanae* Cochran (described from Booby Cay off the east end of Mayaguana Island), and *S. caicosensis* Cochran (described from South Caicos Island and Long Cay). No species of *Sphaerodactylus* have been reported from islands on the Crooked Island Bank or the Turks Bank. The purpose of the present paper is to discuss the *Sphaerodactylus* of the Bahama Islands (including the Caicos and Turks banks) with the exceptions of the three species noted above (*S. notatus*, *S. decoratus*, *S. inaguae*) and "*S. anthracinus*."

I have examined a total of 623 *Sphaerodactylus* from the islands south of the Crooked Island Passage and including Rum Cay and San Salvador. In the field I have had the enthusiastic assistance of Messrs. David C. Leber (Turks and Caicos banks) and Richard Thomas (Rum Cay and San Salvador). In addition, Messrs. Dennis R. Paulson and C. Rhea Warren have made a point of collecting *Sphaerodactylus* for me on San Salvador (and its associated cays) and Mayaguana respectively. Mr. Thomas secured a fine series of geckos on Acklin's Island. I have borrowed specimens from the following collections and wish to express my gratitude to the respective curators and their assistants for the loan of pertinent material: American Museum of Natural History (AMNH),

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Charles M. Bogert; Museum of Comparative Zoology (MCZ), Ernest E. Williams; Museum of Zoology, University of Michigan (UMMZ), Charles F. Walker and Dale L. Hoyt; United States National Museum (USNM), Doris M. Cochran. Additional specimens in the Albert Schwartz Field Series (ASFS) and the collection of Richard Thomas (RT) have also been studied. Specimens of new forms have been placed in the above collections and in the Carnegie Museum (CM) and the University of Illinois Museum of Natural History (UIMNH). The illustrations are once more the work of F. Wayne King. I am very grateful to him for his labors on my behalf; his plates add greatly to a visualization of the patterns of these geckos.

I wish especially to call attention to the collections made by George B. Rabb on the Van Voast-American Museum of Natural History Bahama Islands Expedition in 1953. Dr. Rabb originally intended working up his collections, and later he and I were to study his and my material jointly. However, pressure of other duties has prevented Dr. Rabb from continuing his portion of the proposed project, and he has very generously relinquished his valuable material (in the American Museum and the University of Michigan) to me for study. The significance of Dr. Rabb's material hardly needs emphasis. Not only did he secure interesting *Sphaerodactylus* from several islands in the southern Bahamas whence the genus had been previously unknown. He collected a fine series of a new form on East Plana Cay (a faunal affiliate of the Crooked Bank islands), an islet difficult of access and rarely visited by naturalists. Dr. Rabb also secured a few *Sphaerodactylus* from islands on the Crooked Island Bank itself. Among other material I studied are lizards from the Turks Islands that were collected by Garth Underwood and deposited in the Museum of Comparative Zoology. Dr. Underwood established the occurrence of the genus on the Turks Bank, an area whence it had been previously unknown. Much other fresh material (collected since 1960) is now available from these southern islands, and it seems appropriate at this time to discuss in detail the variation of the forms involved.

All the species discussed herein share a community of characters: keeled and imbricate dorsal scales with hairbearing scale organs only, often at least weakly keeled throat scales, and smooth ventrals. As a group they thus differ from S. *notatus* and S. *inaguae* in that these two species always have smooth throat scales, keeled imbricate dorsals, and smooth ventrals. The general resemblances between the species discussed in the present paper and S. *notatus* and S. *inaguae* in details of

scalation might suggest that the former are direct derivatives of *S. notatus*. I do not feel that this is the case, and an extended discussion of the herpetogeography of the Bahamian archipelago is presented to substantiate my conclusions.

SYSTEMATIC REVIEW

Sphaerodactylus corticola[1] Garman, 1888

Sphaerodactylus corticolus Garman, 1888, Bull. Essex Inst., 20:111.

TYPE LOCALITY: Rum Cay, Bahama Islands; syntypes MCZ 6219—four specimens.

DISTRIBUTION: Rum Cay, San Salvador Island (including Green Cay, Low Cay, and Man Head Cay), East Plana Cay, and islands of the Crooked Island Bank (Acklin's Island, North Cay, Fish Cay, Fortune Island, Castle Island); see fig. 1.

DEFINITION: A species of *Sphaerodactylus* with small, acute, strongly keeled, flattened, imbricate dorsal scales, axilla to groin 33—58; no area of middorsal granules or granular scales; dorsal scales with 4 to 7 hairbearing organs (1 or 2 hairs) on posterior margin. Dorsal scales of tail keeled basally, smooth distally, acute, imbricate, and flat-lying; ventral scales of tail smooth, rounded, enlarged midventrally; gular scales variable from keeled to smooth, but keeling (if present) weak and not prominent and often shown on only a few scales; chest scales smooth; ventrals rounded, imbricate, smooth, axilla to groin 26—43; scales around midbody 48—84; internasals 0—2 (mode 1); upper labials to mid-eye, 3 (occasionally 4); escutcheon with short compact central area and extensions onto thigh to near underside of knee (4—9 scales in length x 12—29 scales in width).

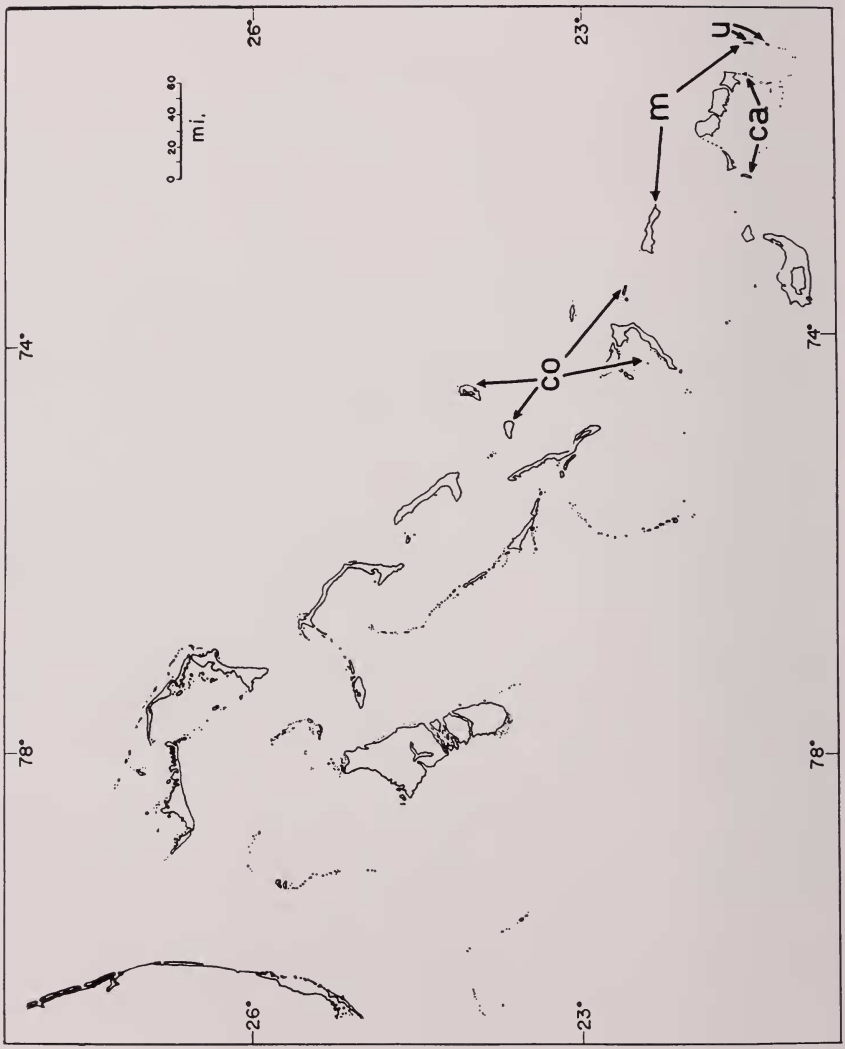
Pattern variable both within populations and between populations; sexual dichromatism absent to weak, and often obscured by pattern variation within a single population. Dorsum varying from medium brown to dark purplish brown in both sexes. Head pattern varying from absent to a weakly to prominently delineated figure composed of (maximally) a broad postocular U and heavy, discrete, dark spots on snout and neck, the snout spots often intermixed with scattered white to pale-gray scales giving a frosted effect. Body pattern varying from rather uniform and fine flecking to heavy dark and light flecking and/or dotting (giving a salt-and-pepper effect), to large discrete but usually diffusely edged dark spots which may in extreme instances fuse to give a pattern of longitudinal markings; adult females occasionally with a pair of vague paler dorsolateral lines, a remnant of the juvenile pattern of some populations. No scapular markings. Iris brown or blue. Habitus stocky; snout short and broad. Adult size (snout-vent length) variable by subspecies from 33 mm. to 39 mm.

Sphaerodactylus corticola corticola Garman, 1888

DISTRIBUTION: Rum Cay, Bahama Islands.

DEFINITION: A subspecies of *S. corticola* characterized by a combination of

[1]see Note 1, Appendix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small size (males and females to 34 mm. snout-vent length), low number (38—46) of dorsal scales between axilla and groin, low number (32—40) of scales around body at midbody, modally 10 fourth-toe lamellae, males with heads either unicolor tan to brown or with dark-brown markings and at times with additional white frosting, venter flesh-colored and never yellow or orange, throat immaculate, and iris brown with yellow pupillary ring (fig. 2A).

DISCUSSION: *S. c. corticola* is represented by 30 specimens from Rum Cay. The syntypic series consists of one adult male (snout-vent length 29 mm.), one adult female (34 mm.), and two subadult specimens (22 and 23 mm.). The largest specimens of each sex have snout-vent lengths of 34 mm. Scale counts on 24 *S. c. corticola* are: dorsals axilla-groin 38—46 (mean 41.9); ventrals axilla-groin 32—40 (35.7); midbody scales 58—72 (64.9); fourth-toe lamellae 7—12 (mode 10, mean 9.4); internasals 1 or 2 (mode 1); escutcheon 5—7 x 19—27.

The nominate subspecies, like other races, is especially variable in dorsal pattern. The dorsal ground color is some shade of tan or brown in life, usually with some sort of dorsal markings. The dorsum may be virtually patternless, having only a vague indication of salt-and-pepper effect (ASFS V10449), or, at the other extreme, may have heavy transverse dark-brown barring (ASFS V10495). The modal condition is the presence dorsally of brown flecking or mottling, at times approaching marbling. There is a tendency for the heavier markings to occur in females, although the crossbarred specimen noted above is a male. The head in both sexes varies with the dorsal color from patternless and concolor, as in ASFS V10500 (tan to brown), to a blotched pattern extending onto the neck (ASFS V10497). In males exhibiting the latter condition, the main head markings consist of a widely opened U, just posterior to the eyes, and a broad median line (sometimes fragmented) on the snout. The remainder of the head is variously marked with relatively large dark-brown dots or blotches. In addition there often are scattered white scales on and between the cephalic dark elements, giving a strikingly frosted appearance. The dark head markings are not correlated with dorsal body markings. For instance, ASFS V10497 has a patterned head but an unpatterned dorsum. Females have the same sort of cephalic pattern as do males (postocular opened U, median snout line) but these features are much less obvious. Females may have white

Fig. 1. Map of the Bahama Islands, showing the known distribution of the four species discussed: **co** = *Sphaerodactylus corticola*, **m** = *S. mariguanae*, **ca** = *S. caicosensis*, **u** = *S. underwoodi*.

frosting, as do males, but regularly lack the dark head spots and blotches that characterize some males.

The venter is flesh colored in life, and the tail may have a slight yellow tinge on the upper surface, but neither venters nor tails are yellow or orange as in one other population of *S. corticola.* Throats in adults of both sexes are immaculate, as is that of the smallest subadult (22 mm. snout-vent length). The iris is brown and has a yellow pupillary ring.

On Rum Cay, *S. c. corticola* was encountered only within the limits of the sole settlement, Port Nelson. Even here it was not especially common in what elsewhere is excellent *Sphaerodactylus* habitat—in *Cocos* trash and under boards and human debris in well shaded (*Cocos, Terminalia*) situations. In more exposed areas, such as open beaches and stands of sea grape (*Coccoloba*), *S. c. corticola* is replaced by *S. decoratus decoratus* Garman. Our collecting on Rum Cay was admittedly very circumscribed geographically, but we had the distinct impression that *S. c. corticola* is much less common there, and much less tolerant of harsh habitats, than *S. d. decoratus.*

SPECIMENS EXAMINED: *Bahama Islands, Rum Cay* (no further locality), 4 (MCZ 6219—syntypes); Port Nelson, 26 (AMNH 76156-76158, ASFS V10447-V10455, ASFS V10495-V10506, RT 1459-1460).

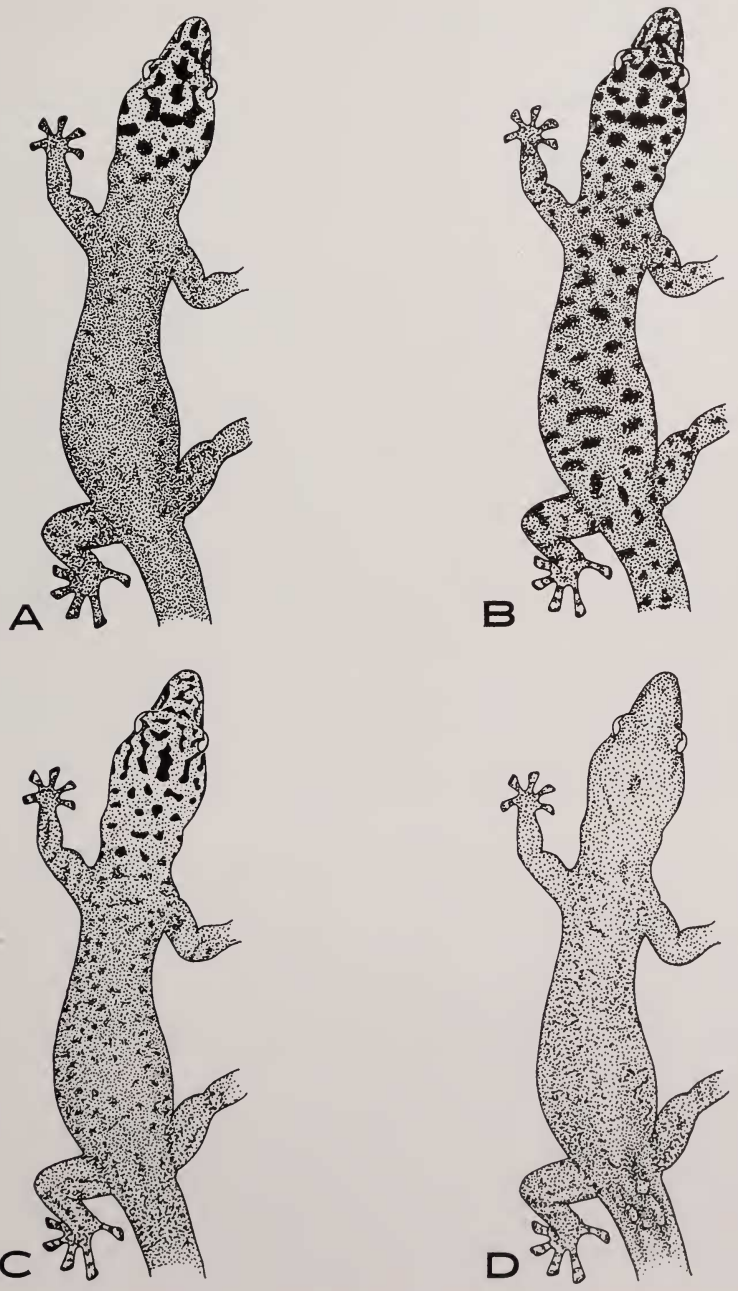
Sphaerodactylus corticola soter[1], new subspecies

HOLOTYPE: CM 40635, adult male, from 1.3 mi. (2.1 km.) S Dixon Hill (= United Estates), San Salvador, Bahama Islands, one of a series taken June 26, 1966 by Richard Thomas. Original number ASFS V10587.

PARATYPES (all from San Salvador, Bahama Islands): ASFS V10588-V10591, RT 1465-1466, same data as holotype; USNM 160701, Cockburn Town, December 28, 1963, native collector; CM 40630-40632, MCZ 92011-92015, UIMNH 66530-66531, USNM 160702-160704, 2.3 mi. (3.7 km.) E Watling's Castle (= Sandy Point House), December 30, 1963, D. R. Paulson; USNM 160700, Cockburn Town, December 30, 1963, D. R. Paulson; AMNH 96516, 4.2 mi. (6.8 km.) N Cockburn Town, June 22, 1966, R. Thomas; AMNH 96517, 6.9 mi. (11.1 km.) by road NE Cockburn Town, June 23, 1966, R. Thomas; ASFS V10582-V10586, 4.2 mi. (6.8 km.) N Cockburn Town, June 26, 1966, R. Thomas; ASFS V10627, hatched from egg taken 4.2 mi. (6.8 km.) N Cockburn Town; ASFS

[1]From Greek *soter,* savior, an allusion to San Salvador.

Fig. 2. Four subspecies of *Sphaerodactylus corticola:* **A,** *S. corticola corticola,* male, ASFS V10497, Port Nelson, Rum Cay; **B,** *S. c. soter,* holotype, male, CM 40635, 1.3 mi. S Dixon Hill, San Salvador; **C,** *S. c. campter,* holotype, male, CM 40636, east of Snug Corner, Acklin's Island; **D,** *S. c. aporrox,* AMNH 76146, holotype, male, East plana Cay.


A
B
C
D

V10747, hatched from egg taken 9.9 mi. (15.9 km.) by road NE Cockburn Town; MCZ 37943-37952, Cockburn Town, March 1934, T. Barbour.

ASSOCIATED SPECIMENS (all from islets that are satellites of San Salvador): *Green Cay,* 10 (UMMZ 115623—8 specimens; ASFS V10626, ASFS V10749); *Man Head Cay,* 2 (ASFS V2335-V2336); *Low Cay,* 1 (ASFS V2427).

DEFINITION: A subspecies of *S. corticola* characterized by a combination of large size (males to 37 mm., females to 39 mm. snout-vent length), high number (42—58) of dorsal scales between axilla and groin, high number (69—84) of scales around body at midbody, modally 10 fourth-toe lamellae, both sexes usually with some dark cephalic pattern, but even when best expressed (in males) less complex than in *S. c. corticola,* white head frosting present in some specimens, venter brightly colored (yellow to orange) rather than flesh, throat usually with some markings (stippled in females, heavy brown spots in males) and iris brown with yellow pupillary ring.

DESCRIPTION OF HOLOTYPE: An adult male with the following measurements and counts: snout-vent length 37 mm., tail 40 mm.; dorsals axilla-groin 54, ventrals axilla-groin 42, midbody scales 81, fourth-toe lamellae 9, internasal 1, escutcheon 5 x 20. Dorsum dark brown with scattered and irregularly shaped darker brown (almost black) spots from the neck onto the upper surface of the tail, with smaller but similarly colored spots on the limbs; snout irregularly covered with very dark brown mottling and irregular white frosting which additionally surrounds a single dark blotch between the orbits; postorbital area of head dark spotted with a more or less tripartite transverse occipital "bar" (fig. 2B); cheeks and lores dark spotted; four dark lines, alternating with whitish lines, radiating ventrally from orbit onto lower labials; lateral surfaces of body spotted like dorsum; venter yellow-gray, heavily stippled with brown; chin and throat concolor with venter but overlaid with coarse dark brown blotches and/or spots of varying sizes, the lateralmost confluent with the dark lines radiating from eye; under side of tail bright yellow; iris brown with yellow pupillary ring.

VARIATION: Scale counts from 40 specimens of *S. c. soter* (including non-paratypic specimens from the satellite islands of San Salvador) are: dorsals axilla-groin 42—58 (50.8); ventrals axilla-groin 34—43 (38.9); midbody scales 69—84 (75.8); fourth-toe lamellae 8—13 (mode 10, mean 9.9); internasals 1 or 2 (mode 1); escutcheon 5—7 x 12—29. The largest male has a snout-vent length of 37 mm., the largest female 39 mm. The larger apparent size of females is presumably due to the larger series of that sex.

Males vary in dorsal color from yellowish tan to dark brown and almost always exhibit variably sized dots or spots on the back (exception—MCZ 37947). Males from mainland San Salvador never have the dorsal spots aligned into longitudinal or transverse rows. The holotype has the head figure maximally expressed. In some males (ASFS V10543), the pattern is almost as well developed, but in other males

the major head pattern element is a dark occipital smudge or spot in the region of the tripartite occipital bar of the holotype. Some males which in life lacked a definitively expressed dark cephalic pattern nonetheless had some white frosting scales on the snout and occiput. Females are much like the males dorsally, except that there may be persistent remnants, in very large females, of a pair of juvenile pale dorsolateral lines, which feebly delimit a middorsal zone in some adult females (ASFS V10589). The variation in density of spotting is much greater in females than in males, since some (ASFS V2344) of the former have the back heavily and finely reticulate with darker coloring. This fine reticulation appears to be a remnant of a similar juvenile pattern. Throats of females are regularly either heavily stippled with dark brown or have a few scattered dark brown flecks on a stippled background. The ventral ground color in both sexes is always some shade of yellow to orange. The holotype represents a pallid extreme (yellow-gray), whereas in many living specimens examined the venter was bright orange. The female head pattern is more complex than that of males, in that there are often indications of a "complete" head pattern—a median short dark line between the eyes and a more or less complete postorbital opened U. In some females (ASFS V10589) this pattern is clearly expressed, whereas in others (ASFS V2340) it is much obscured by deposition of dark and white flecking and frosting. In others (ASFS 10584) the U is incomplete centrally, producing a pair of dark postocular longitudinal dashes. The differences between males and females in head pattern are not striking; the cephalic pattern is especially variable for a *Sphaerodactylus*. Both sexes may have white snout frosting.

A single juvenile (ASFS V10586; snout-vent length 23 mm.) was described in life as follows: dark rich brown dorsum with a pair of cream dorsolateral nuchal and suprascapular lines and a series of tiny white ocelli on the back between the dorsolateral lines; two pairs of orange ocelli on the base of the tail, throat yellowish, ventral color gray, under side of the tail orange. As previously noted, some juveniles of this size lack the dorsolateral pale lines and are reticulate dorsally.

The series of ten *S. c. soter* from Green Cay are not different chromatically from their mainland San Salvador relatives, and the same is true of the single male from Low Cay. The female from Man Head Cay resembles San Salvador *S. c. soter*, but the male from this island is radically different in pattern. The male has four rather regular longi-

tudinal dark stripes composed of large squarish blotches more or less fused with one another—two of these stripes on the back and one on each side. The throat is only lightly stippled. No other *S. corticola* examined has such a peculiarly aberrant pattern.

COMPARISONS: *S. c. soter* differs from *S. c. corticola* both in scalation and pigmentation. The brightly colored venters of the former contrast with the pale bellies of the latter. The average of counts of dorsal and midbody scales in *S. c. soter* is greater than that of similar counts in the nominate form. The most clear-cut scale difference is in number of midbody scales, which range from 58 to 72 in *S. c. corticola* and 69 to 84 in *S. c. soter*. The distinctly larger adult size and greater bulk of *S. c. soter* over *S. c. corticola* are easily observed when adults of the two subspecies are compared. Differences in head and throat pattern include immaculate throats of the nominate form in contrast to the stippled or often heavily spotted throats of *S. c. soter* males and the more completely expressed head pattern of *S. c. corticola* of which *S. c. soter* shows only the most basic remnants.

REMARKS: *S. c. soter*, in contrast to *S. c. corticola*, occupies a variety of habitats on San Salvador. Specimens were taken under palm (*Thrinax*) leaves on the beach, under boards adjacent to ruins in low coppice, in a pile of *Sabal* trash, and under small rocks at the base of a large roadside tamarind (*Tamarindus*). On Man Head and Low cays specimens were taken under flat rocks among strand plants, and one specimen from Green Cay (where the species is fairly abundant) was taken from a pile of rocks (also occupied by an Audubon's Shearwater, *Puffinus lherminieri* Lesson) in a *Coccoloba* thicket. On San Salvador, *Sphaerodactylus* eggs were abundant, and were encountered frequently under trash in low moist areas grown to palms and ferns. We never found the lizards themselves in such situations, however, and in fact *S. c. soter*, despite the fairly long series, seemed distinctly difficult to secure. The presence of *S. c. soter* in habitats more arid and exposed than those of *S. c. corticola* may be due to the absence of *S. d. decoratus* on San Salvador. On Rum Cay, the two species are divided between the mesic and arid habitats.

Six eggs of *S. c. soter* varied in size between 7.5 and 8.4 mm. in length and 5.9 and 6.3 mm. in width. Hatchlings measure 16 or 17 mm. in snout-vent length.

Sphaerodactylus corticola **campter**[1], new subspecies

HOLOTYPE: CM 40636, an adult male, from east of Snug Corner, Acklin's Island, Bahama Islands, one of a series taken October 24, 1966 by Richard Thomas. Original number ASFS V11021.

PARATYPES (all from Acklin's Island, Bahama Islands): ASFS V11022-V11032, same data as holotype; MCZ 92016-92020, same locality as holotype, October 20, 1966, R. Thomas; ASFS V10964-V10967, Snug Corner, October 21, 1966, R. Thomas; ASFS V10961-V10971, USNM 160706-160713, less than 1 km. S Snug Corner, October 21, 1966, R. Thomas; USNM 160705, beach area west of Chester on The Going Through, October 26, 1966, R. Thomas.

ASSOCIATED SPECIMENS: *Bahama Islands, Crooked Island Bank, North Cay,* 7 (AMNH 76150-76155, MCZ 57427); *Fish Cay,* 1 (ASFS V8769); *Fortune Island,* Albert Town, 2 (UMMZ 115620); *Castle Island,* north coast, 3 (MCZ 57428-57430).

DEFINITION: A subspecies of *S. corticola* characterized by a combination of small size (both sexes to 33 mm. snout-vent length), moderate number (42—50) of dorsal scales between axilla and groin, moderate number (61—70) of scales around body at midbody, modally 9 fourth-toe lamellae, both sexes with or without dark pattern on a yellow head, the head coloration in contrast to that of the remainder of dorsal color, no white head frosting, venter flesh colored, throat usually immaculate or with at most a few faint scattered dark-brown flecks, and iris color gray with a blue pupillary ring which may vary in width.

DESCRIPTION OF HOLOTYPE: An adult male with the following measurements and counts: snout-vent length 33 mm., tail 34 mm.; dorsals axilla-groin 46, ventrals axilla-groin 33, midbody scales 68, fourth-toe lamellae 8, internasal 1, escutcheon 7 x 24. Dorsum gray-brown with head and upper surface of tail dull yellow-brown in distinct contrast to color of back; dorsum with faint scattered darker isolated scales giving an open salt-and-pepper effect; head with a dark and distinct cephalic pattern consisting of two fragmented transverse snout bars, three irregular marks between the eyes, and three longitudinal dark lines (two postocular, one median) behind the eyes, followed by discrete dark spots on the occiput and onto the neck; a bold lower postocular stripe on each side (fig. 2C); cheeks and anterior lateral portion of neck spotted with dark brown; infralabials flecked with brown; throat unstippled whitish with scattered brown flecks; venter pinkish gray; tail regenerated, yellow-brown above, flesh below, unpatterned; iris gray with sky-blue pupillary ring.

VARIATION: Scale counts from 18 specimens of *S. c. campter* (from Acklin's Island only) are: dorsals axilla-groin 42—50 (45.3); ventrals axilla-groin 32—42 (35.5); midbody scales 61—70 (65.5); fourth-toe lamellae 7—11 (mode 9, mean 9.6); internasals 0-2 (mode 1); escutcheon 5—7 x 24—29. The largest specimens of each sex have snout-vent lengths of 33 mm.

There are only three Acklin's Island males available—the holotype

[1]From Greek *campter,* crooked.

and two paratypes. The latter specimens resemble the holotype in chromatic details, but lack any indication of head spotting or marking, although the head color in life was yellow-brown in contrast to the gray-brown of the back. The unregenerated tails of the two male paratypes are vaguely marbled with gray.

The series of Acklin's Island females varies in dorsal color from dark gray-brown to brown and has the heads and upper surfaces of the tails dull yellow-brown as in the males. All females show some dorsal body markings, usually in the form of scattered dark scales giving an open salt-and-pepper effect. Some females, however, (ASFS V10967) are very densely dotted and/or vermiculate above, whereas others (ASFS V10965) are vaguely spotted with brownish above. Female head patterns are variable. At one extreme are geckos with head patterns as distinct as, or even more fully expressed than, that described for the holotype. Such females may have a more or less complete dark U and a median line on the occiput, but more often these elements are fragmented. The balance of the head may also be marked with dark dots or irregular blotches, which at times include a transverse pair of dark preorbital lines. At the other extreme are females that lack any demonstrable head pattern and are like the paratype males noted above. In both categories (patterned and unpatterned heads) adults, subadults and juveniles occur, hence these differences are not attributable to ontogenetic change. Throats of females are whitish without stippling or flecking, and venters are pinkish gray.

The iris color in *S. c. campter* is gray, the pupillary ring is sky-blue, and in some specimens the blue ring color is more extensive and invades the iris more fully, with a resulting blue-gray iris.

COMPARISONS: *S. c. campter* differs from *S. c. corticola* and *S. c. soter* in having the head and dorsal surface tail coloration distinctly different from that of the body. It is smaller than *S. c. soter,* and about equal in size to *S. c. corticola.* In both dorsal scales and midbody scales, *S. c. campter* is intermediate between *S. c. corticola* and *S. c. soter,* although in the midbody-scale count the mean is much closer to that of *S. c. corticola.* In having a flesh colored venter, *S. c. campter* resembles *S. c. corticola* and differs from *S. c. soter* which has a yellow or orange venter. The head pattern of *S. c. campter* (when expressed) is clear and vivid, lacks any white frosting (which occurs in *S. c. corticola* and *S. c. soter*), and is more "complete" than the patterns in the other two subspecies. The body pattern of *S. c. campter* rarely demonstrates the large dark

blotches of *S. c. corticola* and *S. c. soter,* whereas these two subspecies rarely show the salt-and-pepper effect of *S. c. campter.* The modal number of 9 fourth-toe lamellae in *S. c. campter* differs from that of 10 in both *S. c. corticola* and *S. c. soter.*

REMARKS: *Sphaerodactylus* previously have been unreported from any island on the Crooked Island Bank. Specimens had been collected there, however, on North Cay and Castle Island, and Dr. Rabb secured specimens on North Cay and Fortune Island. These specimens, coupled with a single *Sphaerodactylus* from Fish Cay taken by C. R. Warren, total only 13 from four separate islands on the bank. There still are no *Sphaerodactylus* from Crooked Island, where it certainly occurs. Richard Thomas's experiences on Acklin's Island indicate that geckos are not common on islands of this bank, and it will remain for future collectors to secure material from Crooked Island.

The specimens from other islands on the Crooked Island Bank agree fairly well chromatically and in pattern with topotypes from Acklin's Island. As far as scalation is concerned, however, there are some peculiarities that prevent me from certainly associating these lizards with *S. c. campter.* The three specimens from Castle Island (MCZ 57428-57430; one male and two females, one of which is too desiccated for detailed study), have dorsal scale counts of 33 and 35, far below the lower extreme of *S. c. campter,* and 48 and 54 midbody scales, counts which are also much lower than those of *S. c. campter* topotypes. The remaining non-Acklin's *Sphaerodactylus* agree far better with Acklin's Island specimens in counts. It seems likely that other subspecies of *S. corticola* will be found to occur on some of these islands on the Crooked Island Bank. The fact that Castle Island lies off the southern tip of Acklin's Island, separated by about two nautical miles of shallow water, makes the differences between the Castle Island specimens and those from Acklin's Island even more puzzling. Additional careful collecting should be as rewarding on the main islands (Fortune, Crooked, Acklin's) and the smaller ones (Castle, North Cay, Fish Cay, Guana Cay, Wood Cay, South Cay), both within and outside of The Bight of Acklin's, as in any area in the Bahamas.

Richard Thomas found *S. c. campter* uncommon in suitable habitat on Acklin's Island. His series of 34 specimens collected in seven days was taken in *Cocos* and *Thrinax* trash in beach situations, and in leaf litter in plantings of fruit trees (orange, sugar-apple, and banana). Like *S. c. soter, S. c. campter* is tolerant of both open and shaded situations.

Sphaerodactylus corticola **aporrox**[1], new subspecies

HOLOTYPE: AMNH 76146, an adult male, from East Plana Cay, Bahama Islands, one of a series taken March 4, 1953 by George B. Rabb. Original number VV-AMNH 1814.

PARATYPES: AMNH 76145, 76147-76149 + five untagged specimens, UMMZ 115619 (ten specimens), same data as holotype.

DEFINITION: A subspecies of *S. corticola* characterized by a combination of large size (both sexes to 37 mm. snout-vent length), moderate number (40—50) of dorsal scales between axilla and groin, moderate number (63—70) of scales around body at midbody, modally 11 fourth-toe lamellae, head pattern entirely absent, dorsum heavily salt-and-pepper with dark and light scales and without large dots or spots, and throat immaculate in both sexes; iris color unknown.

DESCRIPTION OF HOLOTYPE: An adult male with the following measurements and counts: snout-vent length 35 mm., tail 31 mm.; dorsals axilla-groin 42, ventrals axilla-groin 30, midbody scales 60, fourth-toe lamellae 10, 1 internasal, escutcheon 6 x 27. Dorsum (as preserved) brown with a vaguely light and dark marbling or salt-and-pepper effect, although there are more dark than light scales (fig. 2D); head concolor with dorsum, without pattern; tail weakly striate basally on unregenerate portion; throat and venter unmarked.

VARIATION: Scale counts from 19 specimens of *S. c. aporrox* are: dorsals axilla-groin 40—50 (44.7); ventrals axilla-groin 29—36 (31.9); midbody scales 63—70 (66.4); fourth-toe lamellae 9—13 (mode 11, mean 11.1); internasals 1 in all specimens; escutcheon 6—8 x 21—28.

S. c. aporrox is the most drab of the four subspecies of *S. corticola*. I have not seen specimens in life but Dr. Rabb advised me (letter of February 23, 1966) that he was impressed by the general drabness of these lizards. The series of *S. c. aporrox* includes nine males, 10 females, and one juvenile (snout-vent length 17 mm.). There is little variation in dorsal pattern except that some individuals are more prominently salt-and-pepper. There is no evidence of head pattern in any individual, and the throats are regularly unmarked. Some females show remnants of the nuchal-scapular pale lines which occur also in *S. c. corticola*. UMMZ 115619 (VV-AMNH 1828) shows these lines most clearly.

COMPARISONS: *S. c. aporrox* requires little comparison with the other subspecies of *S. corticola*. Even though there are no available data on color in life, the pale dorsum, patternless head, and absence of discrete dorsal spotting or dotting all serve to differentiate *S. c. aporrox* from the remaining subspecies. I suspect that the iris color of the East Plana Cay subspecies will be found to be gray and the venter flesh

[1]From Greek *aporrox*, a piece broken off, an allusion to the separation of the range of this subspecies from the main body of the species.

colored, as in the geographically adjacent S. *c. campter*. On the basis of scalation, S. *c. aporrox* is closest to S. *c. campter* in number of dorsal scales, and quite comparable to both S. *c. campter* and S. *c. corticola* in midbody scales. The modal number of 11 fourth-toe lamellae distinguishes S. *c. aporrox* from the three other subspecies with lamellar modes of 9 or 10. Finally, S. *c. aporrox* is a large subspecies, like S. *c. soter*. Some female S. *c. aporrox* are like some female S. *c. soter* in having dorsolateral lines on the neck and shoulder region.

REMARKS: Dr. Rabb's field notes indicate that S. *c. aporrox* is common under silver-palm fronds and in fallen palm logs. East Plana Cay is generally xeric and open, with a flora of thatch palms and low shrubs (Rabb and Hayden, 1957:34).

Sphaerodactylus mariguanae Cochran, 1934

Sphaerodactylus mariguanae Cochran, 1934, Smithsonian Misc. Coll., 92(7):9.

TYPE LOCALITY: Booby Island (= Booby Cay), east of Mariguana Cay (= Mayaguana Island), Bahama Islands; holotype USNM 81381.

DISTRIBUTION: Mayaguana Island (including Booby Cay) in the Bahama Islands, and Grand Turk Island in the Turks Islands; see fig. 1.

DEFINITION: A species of *Sphaerodactylus* with small, acute, strongly keeled, flattened, imbricate dorsal scales, axilla to groin 37—47; no area of middorsal granules or granular scales; dorsal scales with 4 to 8 hairbearing organs (usually 1, occasionally 2 hairs) on posterior margin. Dorsal scales of tail keeled basally, smooth distally, acute, imbricate, and flat-lying; ventral scales of tail smooth, rounded, enlarged midventrally; gular scales variable, from weakly to strongly keeled or even occasionally smooth, but even when keeling present, it is weak and often expressed on only one or two transverse rows of gular scales; chest scales smooth; ventrals rounded, imbricate, smooth, axilla to groin 29—41; scales around midbody 57—71; internasals 0—2 (mode 1); upper labials to mid-eye 3 (occasionally 2); escutcheon with short compact central area and extensions onto thigh to near under side of knee (4—7 x 15—34).

Pattern variable both within and between populations; sexual dichromatism absent to weak and often obscured by pattern variation within a single population. Dorsum gray tan, yellowish tan, to deep dull brown. Head pattern basically consisting of (1) a plain or lightly stippled snout, (2) a postocular dark U including within itself a dark short longitudinal dash or line beginning between the eyes and extending posteriorly, (3) an hour-glass-shaped occipito-nuchal figure, the anterior portion of which is smaller than the posterior portion, (4) a black or dark brown scapular spot outlined anteriorly by a pale (yellowish) straight line, and (5) an extremely elongate U beginning at the posterior corner of the eyes on each side and extending along the neck to end behind, and separated from, the scapular spot. Body pattern variable from completely unspotted or dotted to irregularly dark and light

mottled, the individual spots never uniform or circular in outline. Iris orange-brown. Habitus long and slim; snout elongate and narrow. Adult size (snout-vent length) 41 mm. in both sexes.

DISCUSSION: *S. mariguanae* is known from three islands in the southern Bahama Islands—Mayaguana and its satellite Booby Cay, and Grand Turk Island on the Turks Bank, about 115 miles to the southeast of Mayaguana. The species was first collected on Grand Turk by Garth Underwood, and later a larger series was taken for me by natives. The material on which the name is based was collected on Booby Cay, and consists of seven paratypes and the holotype. *S. mariguanae* has not been reported previously from Mayaguana proper, but its occurrence there was strongly suspected, and material was obtained by Dr. Rabb. A recent visit (June, 1967) to Booby Cay by C. Rhea Warren has clarified the status of the population at the type locality. My previous study of only the paratypic series left in doubt the nomenclatural status of the material from Mayaguana, and Mr. Warren's excellent Booby Cay series has aided immeasurably in this matter.

Differences in scalation between the Booby Cay, Mayaguana, and Grand Turk lizards are slight. Twenty-eight Booby Cay specimens have the following counts: dorsals axilla-groin 37—46 (41.6); ventrals axilla-groin 29—40 (35.0); midbody scales 58—70 (64.4); fourth toe lamellae 10—14 (no mode, 10, 11, 12 with equal incidence; mean 11.5); internasals 1—2 (mode 1); escutcheon 3—6 x 10—31. Forty-eight specimens from Mayaguana have the following counts: dorsals axilla-groin 38—47 (43.1); ventrals axilla-groin 31—41 (34.7); midbody scales 57—71 (64.7; fourth-toe lamellae 8—14 (mode 11, mean 11.1); internasals 0—2 (mode 1); escutcheon 4—7 x 12—28. Forty Grand Turk lizards have the following counts: dorsals axilla-groin 38—46 (41.6); ventrals axilla-groin 31—40 (34.9); midbody scales 58—69 (62.1); fourth-toe lamellae 9—14 (mode 11, mean 11.1); internasals 0—1 (mode 1); escutcheon 4—7 x 26—34. The largest Booby Cay specimens (both sexes) have snout-vent lengths of 41 mm., the largest Mayaguana males have snout-vent lengths of 38 mm., and the largest Mayaguana females measure 39 mm. snout-vent length, whereas the largest members of both sexes from Grand Turk measure 40 mm. in snout-vent length. From the above data, it is obvious that, despite some slight differences in over-all size and scalation between the various populations, the three samples are extremely close in these characters.

On the other hand, differences in pattern are well marked (disregarding for the moment topotypes from Booby Cay). Mayaguana lizards

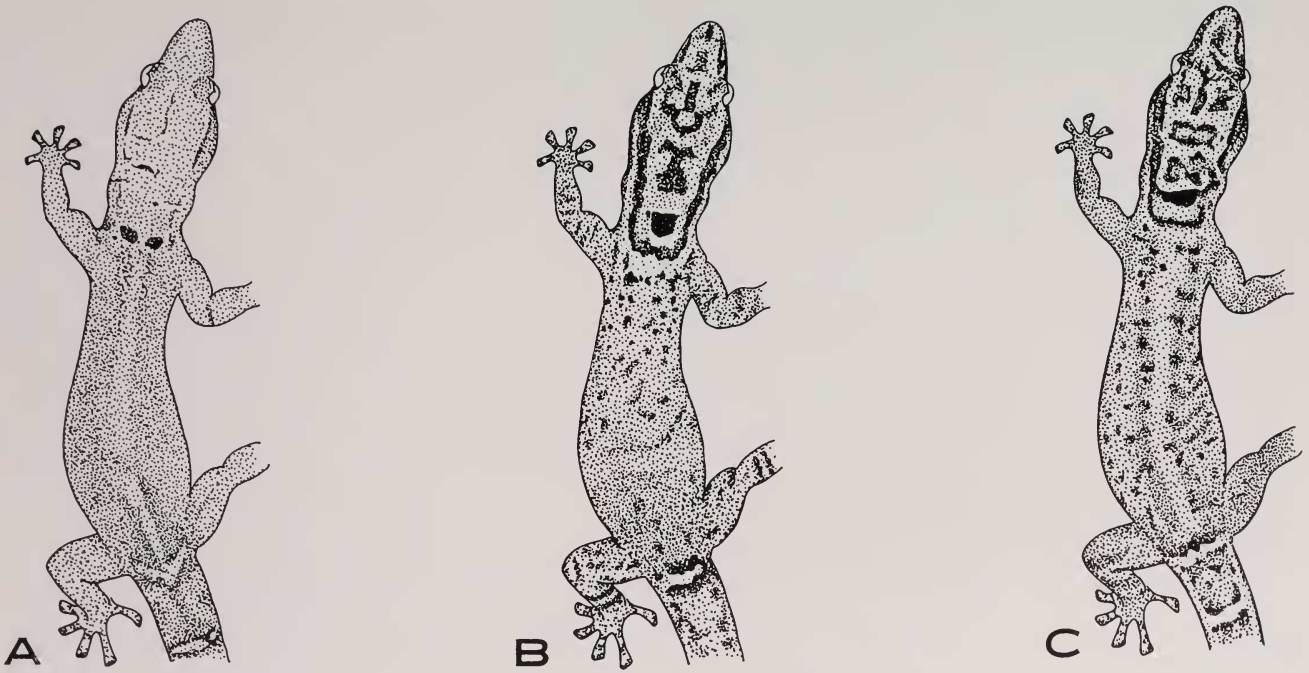


Fig. 3. Representatives of three populations of *Sphaerodactylus mariguanae,* showing differences in pattern and extent of scapular spot; **A,** paratype, male, USNM 81382, Booby Cay; **B,** female, ASFS V8925, Abraham's Bay, Mayaguana; **C,** male, ASFS 10766, Cockburn Town, Grand Turk.

are tan to deep dull brown dorsally, whereas those from Grand Turk are pale tan to yellowish tan in life. The venter in both samples is whitish flesh to creamy or white. The tails are yellow above. In these chromatic features the two major samples resemble one another. The head and scapular patterns, however, show the following. Mayaguana *S. mariguanae* have the most complete head pattern (fig. 3B). The description given in the definition above is based upon a female Mayaguana lizard (ASFS V8925), although most females do not show the entire head pattern so diagrammatically. Fragmentation and fusion of the postocular lines, combination of the scapular spot with the posterior base of the U, or the deposition of obliterative dark pigment in the inter-line spaces on the head are the common conditions. Regularly there is, however, a large black or brown scapular spot, outlined anteriorly by a transverse pale line. The dorsa are variously mottled with dark brown (sometimes with paler brown admixed) and none is completely devoid of pattern. There are usually about four transverse buff bars or bar fragments on the proximal portion of the tail. Mayaguana males are like females in most pattern features, but the median hour-glass is often very boldly delineated and less fragmented than it is in most females. Some males (ASFS V8906) are virtually patternless dorsally and in some the scapular spot is indicated only by a faintly darker smudge on the brown ground color, or is entirely absent. There are males which lack any indication of a head pattern (ASFS V8906, V11238), and in them the head had a dull yellowish tinge in life. Such males without cephalic pattern are in the minority.

Grand Turk males on the other hand have the head pattern obliterated, fragmented, or both (fig. 3C). The median hour-glass is seldom complete and is regularly separated into two distinct blotches, one anterior and the other posterior, or is so grossly fragmented as to be unrecognizable. The scapular spot is, at best, a narrow transverse crescent, never a blotch, outlined anteriorly by pale color. In most males the spot is extremely faint or absent. The space between the hour-glass figure and the posterior part of the U is filled in by two (occasionally three) pairs of symmetrically placed squarish brownish blotches, hollowed (paler) centrally. Dorsal body markings are variable, but there is a tendency for the dark markings on Grand Turk lizards to be more coarse than those on males from Mayaguana. Grand Turk females follow the males in pattern reduction: the scapular spot is reduced to a fine and narrow crescent or is absent. In other cephalic features the two sexes are identical.

The Booby Cay *S. mariguanae* are peculiar. The three paratypic males all show reduced patterns both on the head and body, and the scapular spot is limited to a pair of tiny dark dots (fig. 3A)—a condition observed in no other *S. mariguanae*. The paratypic females from Booby Cay have a crescentic scapular spot and fairly complete head pattern with the hour-glass figure present. A subadult paratypic female has a pair of scapular dots like the three paratypic males. Cochran's (1934:10) description of the coloration and pattern of the holotype ("a trace of a sepia-edged nuchal crescentic marking; . . . top and sides of head drab, immaculate") indicates that the holotype also has a very reduced pattern. Judging only from the original series of topotypic *S. mariguanae*, the Booby Cay lizards are distinctive in that both sexes have the scapular patch much reduced, and that in males this feature may be reduced to no more than two isolated dark scapular dots.

The new series of 21 Booby Cay *S. mariguanae*, however, negates the differences between the original material and mainland Mayaguana lizards. There are some relatively minor distinctions between the two samples. The dorsal ground color of the fresh Booby Cay material was gray to dull brown, rather than tan to brown as on Mayaguana. The paler coloration of the Booby Cay specimens is still obvious when they are compared with Mayaguana geckos collected and preserved at the same time. In general, the cephalic pattern of males from Booby Cay is much more obscure than that of Mayaguana lizards (or is absent), and the scapular spot is very often absent or reduced. In none of the fresh Booby Cay lizards is the spot bipartite as it is in the paratypic males. Fresh females from Booby Cay have the cephalic pattern obliterated, but the scapular spot is developed as well as in Mayaguana females. One Booby Cay female (ASFS V11297) has a pair of hollowed squares on the neck just anterior to the scapular region, but lacks a scapular spot. In having the hollowed squares in this position, this female resembles the usual condition of Grand Turk *S. mariguanae*.

The Booby Cay specimens, taken as a group, do indeed show some divergence from their relatives on Mayaguana, and I had considered naming the latter population as distinct. However, I do not feel that the differentiation has reached a degree that should be formally recognized. I have also refrained from naming the Grand Turk population as different from that of Mayaguana-Booby Cay, although I am reasonably sure that it is distinctive, primarily on the pattern differences between the two populations discussed above.

Reluctance in naming the Grand Turk *S. mariguanae* stems principally from the facts of the widely disjunct distribution of the two populations, and the occurrence of *S. mariguanae* on only one island on the Turks Bank. This latter situation suggests that perhaps the Grand Turk lizards are the result of fortuitous introduction of *S. mariguanae* on that island. If the Grand Turk lizards are the result of human introduction, I doubt that they have come from Mayaguana, since the pattern differences between the two populations are quite strong. In some ways, the Grand Turk lizards more closely resemble topotypic *S. mariguanae* than they do Mayaguana lizards, but it seems extremely unlikely that there has been an introduction from seldom-visited Booby Cay to Grand Turk.

It also seems likely that additional collecting on the Caicos Bank islands, which lie more or less between Mayaguana and the Turks Bank, will reveal the presence of *S. mariguanae* there. The Caicos Islands have been little explored herpetologically (with the exception of South Caicos, which is of ready access, and West Caicos). Such large, northern Caicos Bank islands as Providenciales, North Caicos, and Grand Caicos remain unknown except for the most casual collections. Finding *S. mariguanae* there would not be surprising. Instead of distinguishing the Mayaguana-Booby Cay lizards from their Grand Turk relatives nomenclatorially, it seems preferable to await material from the Caicos Bank.

Mayaguana Island is inhabited by two species of reptiles (no amphibians occur there)—*S. mariguanae* and *Anolis scriptus* Garman. Booby Cay also has *Cyclura carinata* Harlan. Both latter species are a portion of the small reptilian fauna of the Turks and Caicos banks, and each likewise has an endemic subspecies: on Mayaguana *Anolis scriptus mariguanae* Cochran, on Booby Cay *Cyclura carinata bartschi* Cochran. It does not seem unlikely that *S. mariguanae* will be found on the Caicos Bank and that there will be several subspecies named from throughout its range.

SPECIMENS EXAMINED: *Bahama Islands, Booby Cay,* 28 (MCZ 38178, USNM 81376-81378, USNM 81380, USNM 81382-81383, paratypes; ASFS V11280-V11300); *Mayaguana Island,* west shore, Abraham's Bay, 36 (AMNH 76140-76144 + 18 untagged specimens; UMMZ 115618—13 specimens); Abraham's Bay, 84 (ASFS V8903-V8941, ASFS V11235-V11279); *Turk's Islands, Grand Turk Island,* Cockburn Town, 156 (MCZ 56304-56317, ASFS 10717-10718, 10731-10787, 10789-10809, 10810-10811, 10813-10816, 10818-10823, 10826-10838, 10858-10889, 10891-10894, 10899).

Sphaerodactylus caicosensis Cochran, 1934

Sphaerodactylus caicosensis Cochran, 1934, Smithsonian Misc. Coll., 92(7):7.

TYPE LOCALITY: South Caicos Island, Caicos Islands.

DISTRIBUTION: Presumably the islands of the Caicos Bank; known from West Caicos, South Caicos, and Long Cay off South Caicos.

DEFINITION: A species of *Sphaerodactylus* with small, acute, strongly keeled, flattened, imbricate dorsal scales, axilla to groin 34—48; no area of middorsal granules or granular scales; dorsal scales with 5 to 7 hairbearing organs (1 or 2 hairs) on posterior margin. Dorsal scales of tail keeled basally, smooth distally, acute, imbricate, and flat-lying; ventral scales of tail smooth, round, enlarged midventrally; gular scales variable, from weakly to fairly strongly keeled or even smooth, keeling when present often shown only on a very few transverse rows of scales; chest scales smooth; ventrals rounded, imbricate, smooth, axilla to groin 27—36; scales around midbody 54—66; internasals 0—2 (mode 1); upper labials to mid-eye 3 (very occasionally 4); escutcheon with short compact central area and extensions onto thighs to near under side of knee (4—9 x 15—28).

Dorsal pattern sexually dichromatic: (1) *Males*—Body grayish to tan above, with head and upper side of tail dull yellow; dorsal pattern finely salt-and-pepper, with occasional individuals showing remnants of crossbands typical of females; head usually immaculate but a few males have head covered with large dark discrete spots—a condition resulting from retention of basic female head pattern (see below) and its further fragmentation and ultimate transition into a fairly boldly spotted head; throat immaculate or with a few dark brown lateral flecks; tail above vaguely marbled with brownish on yellow ground, yellow below. (2) *Females*—Dorsal ground color grayish to tan but head not dull yellow; body pattern consist-of a series of seven or eight transverse dark brown bars with irregular edges, the first two of which are on the neck and scapular regions; head pattern composed of (a) a brown loreotemporal line on each side, ending on the occiput, at times joined to its mate by the first transverse dark bar on the neck, and (b) an isolated, dark, median line from between the eyes onto the occiput, usually expanded and sharply distinct posteriorly, but at times fused with the first transverse dark neck bar, or fragmented (fig. 4A).

Throat immaculate; under side of tail pinkish orange. Iris color unrecorded. Habitus short and slim; snout moderately elongate and acute. Adult size (snout-vent length) 32 mm. in both sexes.

DISCUSSION: Described on the basis of two females from South Caicos and Long Cay, *S. caicosensis* has since been found to be abundant on South Caicos and to occur also at the western extreme of the Caicos Islands arc on West Caicos. Doubtless it will be found to occur on at least the major intermediate islands (Providenciales, North Caicos, Grand Caicos, East Caicos). The color and pattern of males have not heretofore been reported. Scale counts on 40 specimens from South Caicos, six from Long Cay (which is separated from South Caicos by a

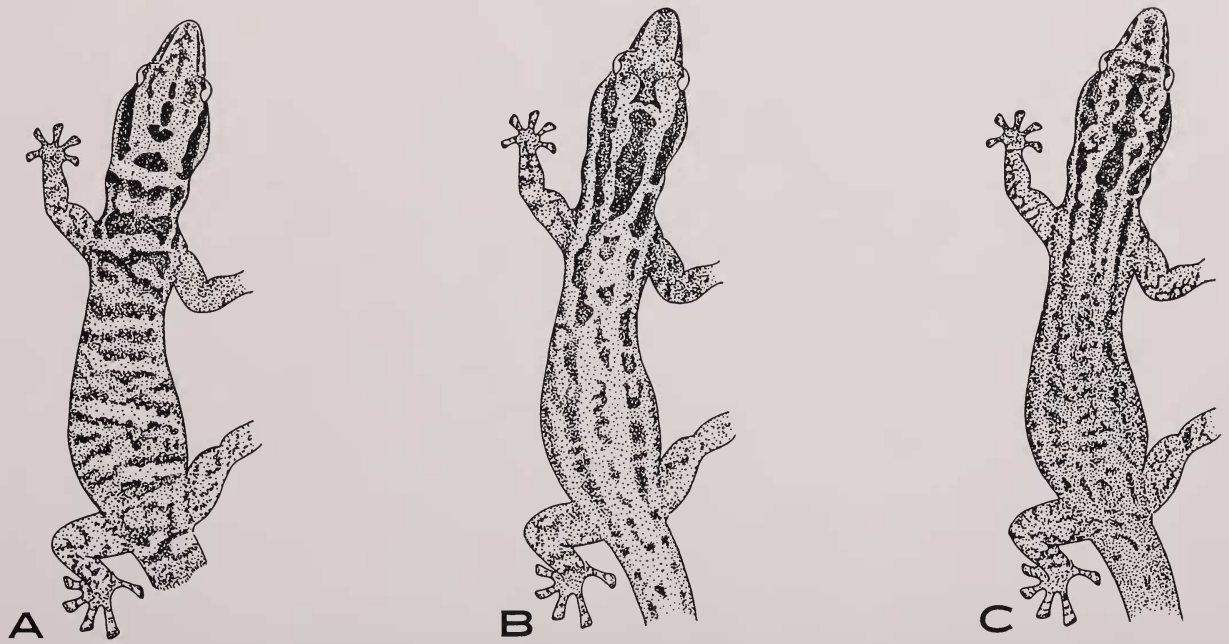


Fig. 4. Two species of southeastern Bahamian geckos: **A,** *S. caicosensis,* female, ASFS 10472, Cockburn Harbour, South Caicos; **B,** *S. underwoodi,* holotype, male, CM 40637, Cockburn Town, Grand Turk; **C,** *S. underwoodi,* female, ASFS 10932, Long Cay, Turks Islands.

narrow channel), and 10 from West Caicos show no significant differences. The largest specimens of both sexes (32 mm.) occur on West Caicos, whereas in the much larger series from South Caicos the largest male has a snout-vent length of 29 mm. and the largest female 31 mm. Scale counts on 40 South Caicos lizards are: dorsals axilla-groin 34—48 (40.6); ventrals axilla-groin 27—36 (31.9); midbody scales 55—65 (60.1); fourth-toe lamellae 6—11 (mode 9 or 10, mean 9.1); internasals 0—1 (mode 1), escutcheon 4—9 x 17—27. Similar counts on ten specimens from West Caicos at the diametrically opposite extreme of the Caicos arc are: dorsals axilla-groin 39—48 (43.2); ventrals axilla-groin 27—35 (32.2); midbody scales 54—66 (60.5); fourth-toe lamellae 9—11 (mode 10, mean 9.8); internasals 1—2 (mode 1); escutcheon 5—6 x 15—28. West Caicos specimens have slightly higher means in several counts, but this is not significant. There probably is a gradual cline in both size (snout-vent length) and numbers of scales from east to west, but material from the intervening islands is lacking.

Although the basic female pattern consists of a series of dark crossbands on a paler ground, many specimens do not show this feature diagrammatically. There are tendencies for the bars to be divided centrally and to be staggered (ASFS 10551), or to be randomly joined by darker pigment *inter se*, or even to be almost completely obliterated (ASFS 10473) with a resultant strong salt-and-pepper appearance. Aside from the usual modifications due to fragmentation and fusion, the cephalic pattern is fairly constant. In some larger females (ASFS 10473) there may be additional dark pigment deposited between the three salient head lines, thus adding a further obscurant. Subadult and juvenile *S. caicosensis* run the same gamut of dorsal pattern variation as do adult females.

Male pattern is as described in the definition of the species. Most males are faintly salt-and-pepper above and have patternless heads. A few males (ASFS 10508) retain the basic trilineate female head pattern with some additional inter-line pigmentation, with the result that two males (ASFS 10509; UMMZ 115622) have the head rather boldly spotted with irregular dark brown blotches. An occasional male (ASFS 10504) shows the barest remnants of the female crossbanding.

REMARKS: A single egg, found in a house in Cockburn Harbour, South Caicos, measured 7.7 x 5.7 mm. The species is apparently very common on South Caicos, but since all our material was gathered by native collectors, I have no precise habitat data for these lizards. I assume, since

all are from an urban area, that they occur under debris in Cockburn Harbour.

Although I think it likely that *S. caicosensis* is a derivative of *S. mariguanae*, the two are no longer so closely related as to be considered subspecies. There are some similarities in head and scapular patterns, but these similarities are negated by the much smaller size, sexual dichromatism, and crossbanded pattern of female *S. caicosensis*. I assume that *S. caicosensis* evolved on the Caicos Bank from an *S. mariguanae* stock, while the latter differentiated on Mayaguana. I postulate also that *S. mariguanae* has re-invaded the Caicos and Turks banks but that it remains as yet uncollected on the former.

SPECIMENS EXAMINED: *Caicos Islands, West Caicos,* eastern end, 14 (UMMZ 115621—3 specimens; UMMZ 115622—11 specimens); *South Caicos,* Cockburn Harbour, 111 (ASFS 10470-10580); Long Cay, 6 (AMNH 76133-76138).

Sphaerodactylus underwoodi[1], *new species*

HOLOTYPE: CM 40637, an adult female, from Cockburn Town, Grand Turk Island, Turks Islands, taken January 26, 1961 by native collector. Original number ASFS 10788.

PARATYPES (all from Grand Turk Island, Turks Islands): AMNH 96518-96521, ASFS 10841-10845, ASFS 10897-10898, ASFS 10900-10905, CM 40633-40634, USNM 160714-160715, same data as holotype; MCZ 56322-56330, same locality as holotype, G. Underwood, July 12, 1955.

ASSOCIATED SPECIMENS: *Turks Islands, Sand Cay,* 4 (MCZ 56318-56321); *Long Cay,* 6 (ASFS 10930-10934, AMNH 76139).

DEFINITION: A species of *Sphaerodactylus* with small, acute, strongly keeled, flattened, imbricate dorsal scales, axilla to groin 29—39; no area of middorsal granules or granular scales; dorsal scales with 3 to 7 hairbearing organs (1 or 2 hairs) on posterior margin. Dorsal scales of tail keeled basally, smooth distally, acute, imbricate, and flat-lying; ventral scales of tail smooth, rounded, enlarged midventrally; gular scales keeled to smooth, with usually at least one transverse row of gular scales having some faint keels; chest scales smooth; ventrals rounded, imbricate, smooth, axilla to groin 25—34; scales around midbody 44—57; internasals 1 or 2 (mode 1); upper labials to mid-eye 3; escutcheon with short and compact central area and extensions onto thighs seldom reaching to behind knee (3—5 x 20—26).

Dorsum tan to chestnut brown, heads yellowish to orange; body and head patterns sexually dichromatic as follows: (1) *Males*—Body pattern immaculate or with widely scattered individual dark scales giving an over-all salt-and-pepper effect; heads without pattern or with an irregular pattern of anastamosing brown

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[1]Named in honor of Dr. Garth Underwood, who first collected *Sphaerodactylus* on the Turks Bank Islands.

markings on a yellow to orange ground; throat immaculate or with some vague darker brown flecking laterally; tails concolor with dorsum and marked with admixed darker brown and gray flecks. (2) *Females*— Basic head pattern consisting of (a) a pair of postocular dark stripes extending onto the anterior dorsolateral region of the body, and (b) a median figure, extending posteriorly from the interocular area onto the neck, twice constricted on the head to give a transversely tripartite element of which the median third is subcircular; on the neck the two dorsolateral dark lines and the median figure continue to the scapular area as a trilineate pattern which becomes lost in the heavily stippled or salt-and-pepper dorsal pattern; throat immaculate. No scapular markings. Iris color unrecorded. Habitus slim; head narrow, snout long and acuminate. Adult size (snout-vent length) 30 mm. in males, 32 mm. in females.

DESCRIPTION OF HOLOTYPE: An adult female with the following measurements and counts: snout-vent length 26 mm., tail 28 mm; dorsals axilla-groin 39, ventrals axilla-groin 28, midbody scales 53, fourth-toe lamellae 12, internasal 1. Dorsum yellowish tan, head distinctly clear yellow; cephalic pattern modified by partition of the median cephalic longitudinal figure to give an anterior median (postocular) triangle, its apex between the eyes, followed by the balance of the figure which is constricted near its anterior end to give a small subcircular area followed by an elongate more or less ovoid element; dorsolateral dark lines extend more or less completely onto the body almost to the groin, and enclose between them a median series of irregularly shaped, elongate, diffuse blotches which represent disjunct continuations of the median head figure, giving the body pattern a distinctly trilineate (three dark lines separated by two pale lines) aspect (fig. 4B); lower sides mottled with brownish; tail basally somewhat lineate (because of extension onto tail of dorsolateral dark lines) and elsewhere grayish, vaguely spotted with darker brownish; throat and venter unspotted.

VARIATION: Scale counts of 19 topotypes are: dorsals axilla-groin 29—39 (34.7); ventrals axilla-groin 25—34 (29.2); midbody scales 44—56 (52.4); fourth-toe lamellae 9—12 (mode 11, mean 10.5); internasals 1 or 2 (mode 1); escutcheon 3—5 x 20—26. The largest Grand Turk male has a snout-vent length of 30 mm., the largest female 28 mm. Data on six specimens from Long Cay are: dorsals axilla-groin 29—38 (34.3); ventrals axilla-groin 27—33 (30.5); midbody scales 48—54 (52.4); fourth-toe lamellae 9—11 (mode 10, mean 10.0); internasals 1; escutcheon 5 x ?. The largest Long Cay male has a snout-vent length of 30 mm., the largest female 31 mm. Three Sand Cay specimens are comparable in counts; data on this short series are: dorsals axilla-groin 29—32 (31.0); ventrals axilla-groin 30—31 (30.3); midbody scales 52—57 (55.0); fourth-toe lamellae 11—12 (mode 11, mean 11.3); internasals 1; escutcheon 4 x ?. Scale differences between these three samples are slight but the material from Sand and Long cays is limited.

Topotypic males are as described in the definition of the species—backs either without pattern or with scattered salt-and-pepper scales,

and patternless heads. One male (ASFS 10897) has the head covered with irregular dark brown vermiculations which are vaguely reminiscent of the basic female head pattern. Grand Turk females are usually heavily dotted dorsally, the markings often arranged in a longitudinally lineate fashion as in the holotype. One apparent female (MCZ 56323) has the body uniformly covered with more or less circular spots. The female head pattern is regularly modified from that described in the definition in that the median head blotch is usually bi- and often tripartite, rather than a continuous median cephalic figure. Some longer preserved females presently lack any indication of head pattern (MCZ 56323, 56326-56327) and some more recently collected females (ASFS 10825) show the same condition.

Of the Sand Cay series (one male, two females, one juvenile), the male resembles Grand Turk specimens. The females and juvenile, however, are distinctly lineate dorsally and the head pattern is complete. Probably these specimens represent a distinct subspecies on Sand Cay, which lies about 6 miles (9.6 kilometers) southwest of Grand Turk.

The male (ASFS 10934) from Long Cay has a heavily spotted head and resembles the single male from Grand Turk with an equally vermiculate head. Five Long Cay females have the boldest and least modified head pattern of any females, with the median cephalic figure complete or almost so, twice constricted, and with the median portion subcircular. These females are also not distinctly lineate dorsally, the backs being fairly regularly salt-and-pepper (fig. 4C). Doubtless these Long Cay lizards should be distinguished nomenclatorially from the remainder of the populations, but the small number available makes this presently a dubious course. The degree of subspeciation in *Leiocephalus arenarius* Barbour on the Turks Bank (Schwartz, 1967) may well be equalled by that of *S. underwoodi*.

DISCUSSION: In contrast to *S. corticola* and *S. mariguanae*, the ultimate relationships of *S. underwoodi* are clear. These lizards are obviously derivatives of *S. difficilis* Barbour of Hispaniola, and *S. underwoodi* might more properly have been named as a subspecies of *S. difficilis*. The situation is comparable to that of *S. inaguae* Noble and Klingel, which I have discussed elsewhere (Schwartz, 1966). *S. inaguae* is also an *S. difficilis* derivative, but because of the complex status of the latter species on Hispaniola (and the fact that several species are confused there under the name *S. difficilis*) it is improvident to add any additional named forms to *S. difficilis* until its own variation is understood. Both

S. inaguae and *S. underwoodi* occupy islands that are peripheral—but not strictly satellite—to Hispaniola, suggesting that differentiation may have reached the specific level in these two cases. In any event, I regard *S. inaguae* and *S. underwoodi* as distinct species.

The Turks Bank lies about 100 miles (160 km.) north of central Hispaniola. Since *S. underwoodi* is related to *S. difficilis*, it is profitable to compare it with (1) topotypes of *S. difficilis* and (2) specimens of *S. difficilis* from the northern Hispaniolan littoral. I have not made scale counts on these Hispaniolan samples but have compared patterns. Perhaps scale counts will reinforce the pattern differences, but for the moment they need not concern us. Comparison of *S. underwoodi* with near topotypes of *S. difficilis* (type locality—La Vega, La Vega Province, Dominican Republic) shows that females of the latter have a small black scapular spot with a single included pale ocellus—features that do not occur in *S. underwoodi*. Three *S. difficilis* samples from the northern Hispaniolan coast have been examined: Cap-Haïtien, Dépt. du Nord, Haiti; vicinity of Monte Cristi, Monte Cristi Province, Dominican Republic; and vicinity of Sosúa, Puerto Plata Province, Dominican Republic. These localities are listed from west to east; Sosúa lies on that portion of the Hispaniolan coast closest to the Turks Bank. Cap-Haïtien specimens have a large black scapular spot and two pale ocelli, Monte Cristi lizards have a tiny dark scapular spot and no ocelli, whereas Sosúa specimens have neither a scapular spot nor ocelli. Thus, the specimens from Sosúa most closely resemble *S. underwoodi* in body pattern. The median head figure in Sosúa females is *triply* constricted to give a series of *four* postocular median spots, and the neck is not so distinctly lineate as in female *S. underwoodi*. Sosúa males are heavily blotched or mottled dorsally. Although I have not made extensive examination of series of *S. difficilis*, keeled throat scales seem to be quite uncommon in that species. Even in the much smaller lot of *S. underwoodi*, there is some keeling on the gular scales of 17 of 30 lizards. *S. underwoodi* from Sand Cay (the island closest to Hispaniola whence *S. underwoodi* has been reported) lack gular keeling completely (four specimens).

From the above brief résumé, it appears that *S. underwoodi* is related to *S. difficilis* of Hispaniola, and shows some similarities to that population of *S. difficilis* which lies closest to it geographically. However, as noted previously, for the moment it seems preferable to consider the two as distinct species.

Although *S. underwoodi* and *S. inaguae* are not sympatric (and indeed their respective ranges are separated by that of the intervening

S. caicosensis), it is pertinent to compare these two species whose common origin has presumably been the Hispaniolan *S. difficilis*. Male *S. inaguae* have the head light gray to bluish, usually heavily overlaid with large dark brown spots or vermiculations. Occasional males have a scapular figure—usually a dark blotch or spot with a pair of buff ocelli —but many males lack any indication of this figure, and even when present the spot is extremely variable in its expression. In *S. underwoodi*, males have the head ground color yellow to orange, rarely have any head spotting or vermiculations, and always lack any expression of a scapular figure. Female *S. inaguae* likewise have the cephalic ground color gray to bluish but the head pattern is more diagrammatically expressed and consists of a dark median line from the snout onto the occiput, usually broken behind the eyes, followed by a disjunct dark patch, at times joined on one or both sides to a dark postocular stripe that extends to above the forelimb insertion. A black scapular patch, outlined at least anteriorly and posteriorly (and sometimes completely) with yellow, may include a pair of yellow ocelli or these may be merged with the posterior yellow border of the scapular patch itself. The scapular patch in turn may be joined with the dark postocular lines on the neck and thus form a fairly extensive figure like that found typically in *S. mariguanae*. In some females the head pattern is faint and very much reduced and the scapular patch is absent. Occasional females have the dorsum irregularly and vaguely crossbanded, somewhat similar to the usual condition in *S. caicosensis*. Female *S. underwoodi* lack scapular markings of any sort and are basically trilineate, in distinct contrast to the condition in *S. inaguae*. In scalation, *S. inaguae* has fewer dorsal scales between the axilla and groin (24—32, mean 27.8) than does *S. underwoodi* (29—39, mean 34.7), although the ranges overlap.

On Grand Turk, *S. underwoodi* can be easily distinguished from *S. mariguanae* by both scalation and pattern. Both dorsal scales between axilla and vent (*mariguanae* 38—46, *underwoodi* 29—39) and midbody scales (*mariguanae* 58—69, *underwoodi* 44—56) are diagnostic. The greater size of *S. mariguanae* (both sexes to 40 mm.) is not matched by *S. underwoodi* (30 mm. in males, 28 in females). The head and scapular patterns of both sexes of *S. mariguanae* differ from the patterned head of female *S. underwoodi* and the unpatterned head of male *S. underwoodi*. Both sexes of *S. underwoodi* lack scapular markings.

REMARKS: Doubtless *S. underwoodi* will be found to occur on other islands on the Turks Bank. It has not as yet been reported from Salt

Cay, the second largest of the Turks Islands. On Grand Turk, all our material was collected within the confines of Cockburn Harbour, where apparently *S. underwoodi* occurs syntopically with *S. mariguanae.*

DISCUSSION

Nine species of *Sphaerodactylus* are now known from the Bahama Islands. These, with their Bahamian subspecies, are:

S. argus Gosse
S. caicosensis Cochran
S. copei cataplexis Schwartz and Thomas (= "*S. anthracinus*")
S. corticola corticola Garman
S. corticola aporrox Schwartz
S. corticola campter Schwartz
S. corticola soter Schwartz
S. decoratus decoratus Garman
S. decoratus atessares Thomas and Schwartz
S. decoratus flavicaudus Barbour
S. decoratus gibbus Barbour
S. inaguae Noble and Klingel
S. mariguanae Cochran
S. notatus amaurus Schwartz
S. notatus peltastes Schwartz
S. underwoodi Schwartz

Two of these (*S. copei, S. argus*), are introduced species. *S. copei* is Hispaniolan and *S. argus* is Jamaican. Both have limited distributions in the Bahamas (*S. copei* on New Providence and Andros, *S. argus* on New Providence and North Bimini) and presumably have reached these destinations through accidental transportation by man. They need not concern us further in the present context.

Of the remaining species, two (*S. decoratus, S. notatus*) occur also in Cuba [and in the latter case also on Isla de Pinos (Isle of Pines), Little Swan Island, and the Florida mainland] and represent Cuban invasions of the Bahama Islands. *S. notatus* is the more widely distributed, occurring on the Little and Great Bahama banks and Cat Island. *S. notatus* is the most widespread of any Bahamian *Sphaerodactylus,* and it is the only sphaerodactyl on the Little Bahama Bank. *S. decoratus* occurs on the Great Bahama Bank, Cat Island, and Rum Cay. *S. decoratus* and *S. notatus* are widely sympatric on the Great

Bank islands and Cat Island, but on Rum Cay, *S. decoratus* occurs only with *S. corticola.*

Two species (*S. inaguae, S. underwoodi*) are Hispaniolan in derivation, since both are related to *S. difficilis. S. inaguae* occurs alone on Great Inagua—a specimen of the Cuban *S. notatus atactus* from Matthew Town, Great Inagua, I attribute to fortuitous human introduction (Schwartz, 1966:179). *S. underwoodi* occurs with *S. mariguanae* on Grand Turk but elsewhere in its distribution is the sole *Sphaerodactylus.*

Three species (*S. corticola, S. mariguanae, S. caicosensis*) cannot be so easily catalogued as to ultimate affinities. *S. corticola* I consider the endemic *Sphaerodactylus* of the Crooked Island Bank (where it is the only sphaerodactyl), whence it has spread to Rum Cay and San Salvador to the north and to East Plana Cay to the east. It may also occur on Atwood's Cay, to the north, but this very rarely visited island is still unrepresented by specimens of *Sphaerodactylus.* Of the two reptiles reported from Atwood's Cay, one (*Anolis scriptus*) occurs on Mayaguana Island, and the other (*Leiocephalus punctatus* Cochran) is the endemic *Leiocephalus* of the Crooked Island Bank.

The relationships of *S. corticola* are not clear. In having the gular scales variably keeled, it resembles *S. mariguanae, S. caicosensis,* and *S. underwoodi.* I do not feel that these four forms represent a single sequential series (which, because of *S. underwoodi,* would necessarily have to be Hispaniolan in origin). The spotted dorsa of some male *S. corticola* suggest a relationship with *S. decoratus* but this is contraindicated by the granular dorsal scales of *S. decoratus.*

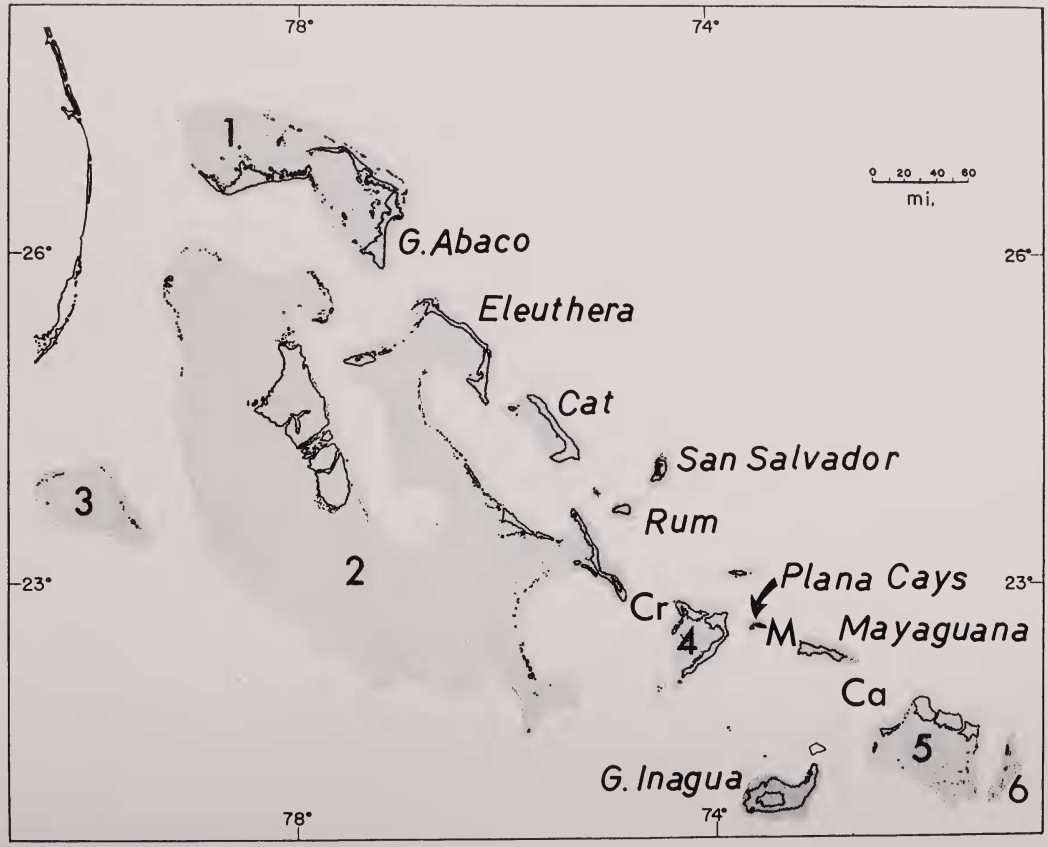
S. mariguanae and *S. caicosensis* are the respective endemics of Mayaguana Island and the Caicos Bank. From its place of origin on Mayaguana, *S. mariguanae* has reached (through natural means?) Grand Turk, where it occurs with *S. underwoodi.* The presumed occurrence of *S. mariguanae* on the Caicos Bank has been commented on before. *S. caicosensis* is presently the only *Sphaerodactylus* known from these islands; certainly *S. mariguanae* is absent from the extreme east and well-collected South Caicos. Possibly *S. mariguanae* and *S. caicosensis* are related, but the strong sexual dichromatism, crossbanded female pattern, and much smaller size of the latter rule out any very close or very recent relationship.

Perhaps the extreme southern Bahamian *Sphaerodactylus* parallel the case of *Leiocephalus arenarius.* I have pointed out (Schwartz, 1967) that *L. arenarius* and *L. inaguae* represent two stocks divergent from the Hispaniolan *L. schreibersi* Gravenhorst, one of which (*L.*

arenarius) has diverged further from its parent stock than has the other (*L. inaguae*). If the same applies to *Sphaerodactylus*, then *S. inaguae* and *S. underwoodi* (both related to *S. difficilis*) and *S. caicosensis* (which is much more divergent than its relatives to the east and west) should all be regarded as ultimately Hispaniolan in origin. There are no data to contraindicate such a relationship, except that *S. caicosensis* disagrees strongly in pattern with any of the Hispaniolan populations of *S. difficilis*. Such disagreement I interpret as indicating a longer period of separation from *S. difficilis*.

The two ultimately Cuban species (*notatus, decoratus*) are widespread in the Bahama Islands but the two (or three, if *caicosensis* is included) Hispaniolan forms have restricted ranges. On the other hand, the two Cuban species have diverged only to the subspecific level from their Cuban relatives (although each has two or more subspecies in the Bahamas) whereas the Hispaniolan forms have diverged sufficiently to be considered full species. This is certainly true for *S. caicosensis*, and possibly less sure for *S. inaguae* and *S. underwoodi* (see Schwartz, 1966:176-178, for detailed rationale for considering *S. inaguae* distinct from both *S. notatus* and *S. difficilis*).

Rabb and Hayden (1957:8) stated that "during the Pliocene the Bahamas were probably completely submerged, and the islands were subject to floodings if not total submergences in the Pleistocene." If the Bahamas have been totally submerged, then in post-Pleistocene time there have evolved some very striking species. This is especially true of the southern islands south of the Crooked Island Passage, including the Turks and Caicos banks, (see fig. 5 for geographic features mentioned in discussion) and much less true of the Great and Little Bahama banks. In fact, as often pointed out, the fauna of the Great and Little banks is, for the most part, an obviously derived one, with Cuba (primarily) and Hispaniola as its sources. Reptiles and amphibians on the Great and Little Banks resemble their Cuban or Hispaniolan counterparts closely, and differences are on the subspecific, rather than specific, level. This relationship is not perfect, nor do I expect it to be. We are dealing, on these two major banks, with a multitude of islands which, although geographically and historically related, may well have had importantly differing histories as far as possibilities for invasion or permanence of fauna are concerned. Nevertheless the contrast between the faunas of the Great and Little banks on one hand and the islands south of the Crooked Island Passage on the other is striking, and merits, es-


78°
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0 20 40 60
mi.
1
G. Abaco
Eleuthera
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San Salvador
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Plana Cays
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2
3
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5
6

pecially with the data presented in the present paper, a closer examination in search of a possible explanation for this dichotomy.

The fauna of the Great Bahama Bank (with Cat Island) includes 20 species. Of them, four (*Tarentola americana, Anolis angusticeps, Ameiva auberi, Chrysemys felis*) are restricted to all or part of the Great Bahama Bank. Two species (*Hyla squirella, Epicrates exsul*) are restricted to the Little Bahama Bank. Of these, the frog is an "introduction" from the Florida mainland and need not concern us further[1]. Fourteen species are primarily Great Bank inhabitants but have been successful in "invading" adjacent banks or islands. These species (with their extra-Great Bank ranges) are: *Hyla septentrionalis* (Little Bank, San Salvador, Rum, Crooked Island Bank), *Eleutherodactylus planirostris* (Little Bank, San Salvador), *Sphaerodactylus decoratus* (Cay Sal Bank, Rum), *Sphaerodactylus notatus* (Little Bank), *Anolis distichus* (Rum, San Salvador), *Anolis sagrei* (Little Bank, Cay Sal Bank, San Salvador, Rum, Crooked Island but not Acklin's Island on the same bank), *Anolis carolinensis* (Cay Sal Bank), *Cyclura* sp. (San Salvador, Crooked Island Bank), *Leiocephalus carinatus* (Little Bank), *Typhlops lumbricalis* (Little Bank),*T. biminiensis* (Cay Sal Bank, Great Inagua), *Epicrates angulifer* (Great Inagua), *Tropidophis canus* (Cay Sal Bank, Great Inagua), *Alsophis vudii* (Little Bank, Crooked Island Bank, Great Inagua).

Of the 20 species listed above, all but five (*Cyclura* sp., *Epicrates exsul, Tropidophis canus, Alsophis vudii, Chrysemys felis*) are closely related to Greater Antillean species, and their Bahamian populations are regarded as identical with, or only racially distinct from, their Cuban or Hispaniolan counterparts. Probably at least *Ch. felis* should be considered a subspecies of the Greater Antillean *Ch. decussata*[2]. The situation with the Bahamian *Cyclura* (except for *C. carinata* south of the Crooked Island Passage) is anomalous. Currently there are six species (*baeolopha, cristata, figginsi, inornata, nuchalis, rileyi*) scattered throughout the

[1]See Note 4., Appendix
[2]See Note 2., Appendix

Fig. 5. Map of Bahama Islands showing names of islands mentioned in the discussion of the herpetogeography of the archipelago. Areas included within the 100-fathom line (and thus delimiting the submarine banks and insular platforms) are shaded. Major banks are: **1,** Little Bahama Bank; **2,** Great Bahama Bank; **3,** Cal Sal Bank; **4,** Crooked Island Bank; **5,** Caicos Bank; **6,** Turks Bank. The three passages referred to in the text are designated: **Cr,** Crooked Island Passage, **M,** Mayaguana Passage, **Ca,** Caicos Passage.

Bahamas. I have seen living or freshly collected examples of all but *baeolopha* and *figginsi* and am not impressed with the characters employed to distinguish some of these "species." Further discussion of Bahamian *Cyclura* must await additional material and study. For convenience in the present context I have designated the Bahamian ground iguanas as *Cyclura* sp., with the full realization that there is probably more than a single species involved. The remaining three species (*E. exsul, T. canus, A. vudii*) are clearly distinct from their Greater Antillean congeners. *E. exsul* is remarkably like *E. gracilis* of Hispaniola and may represent a long-separated Hispaniolan element on the Little Bahama Bank. It is the only native Bahamian amphibian or reptile whose range is limited to the Little Bank.

One other aspect of the Great Bank herpetofauna requires comment. Seven species (*H. septenrionalis, E. planirostris, S. notatus, A. sagrei, L. carinatus, T. lumbricalis, A. vudii*) have reached the Little Bahama Bank and comprise (along with *E. exsul*) the fauna of the Little Bank islands. Ten species (*H. septentrionalis, E. planirostris, S. decoratus, A. distichus, A. sagrei, Cyclura* sp., *T. biminiensis, E. angulifer, T. canus, A. vudii*) have reached either individual islands on their own banks (Rum, San Salvador) or have crossed the Crooked Island Passage to arrive at the Crooked Island Bank. Some of these arrivals may be fairly recent. The occurrence of *A. sagrei* on Crooked Island but not on the immediately adjacent Acklin's Island serves to illustrate this point. The four snakes among the 10 species above have gone far beyond the Crooked Island Passage and have isolated outliers on the Great Inagua Bank.

Southeast of the Crooked Island Passage lies a series of islands and banks (Crooked Island Bank with Atwood's Cay and the Plana Cays, Mayaguana, Great and Little Inagua, Caicos and Turks banks) whose fauna, along with that of the more northern but isolated San Salvador and Rum Cay, is quite different from the Great-Little banks fauna. The species involved here are: *Aristelliger barbouri, Aristelliger* sp. (Six Hill Cay), *Sphaerodactylus caicosensis, S. corticola, S. inaguae, S. underwoodi, Anolis brunneus, A. scriptus, Cyclura carinata, Leiocephalus greenwayi, L. inaguae, L. loxogrammus, L. punctatus, L. arenarius, Ameiva maynardi, Mabuya mabouya, Leptotyphlops columbi, Epicrates chrysogaster, Tropidophis greenwayi, Chrysemys malonei.* All but one (*Mabuya*) are endemic to this region. *Anolis brunneus* is a distinctive *carolinensis*-group anole on the Crooked Island Bank. I do not consider it as having been derived directly from *A. carolinensis* on the adjacent

Great Bahama Bank. *Leiocephalus punctatus* and *L. greenwayi* are related to *L. carinatus, L. loxogrammus* to *L. raviceps in* Cuba, and *L. arenarius* and *L. inaguae* to *L. schreibersi* of Hispaniola. *Ameiva maynardi* and *Aristelliger barbouri* likewise have Hispaniolan affinities[1]. The *Sphaerodactylus* have been previously discussed in detail. The remaining species are of uncertain affinities, although *A. scriptus* is related to *A. cristatellus* Duméril and Bibron of Puerto Rico. The absence of *Eleutherodactylus* south of the Crooked Island Passage and of *Hyla* south of the Mayaguana Passage (between Acklin's Island and Mayaguana) results in the absence of any Bahamian frogs—or frogs of any origin—in the southern islands[2].

There thus appear to have been two major centers of differentiation in the Bahamas. One is the Great Bank, whence a few species have reached the Little Bank to the north and some have reached outlying isolated islands such as San Salvador and Rum, or have been able to cross the Crooked Island Passage with varying success. The other center is the islands south of the Crooked Island Passage, including Rum Cay and San Salvador, whence no species has invaded the Great Bahama Bank. The degree of differentiation of these two basic Bahamian faunas is strikingly different. The northern Little-Great Bank fauna is composed primarily of subspecies whose relationships are clearly with Greater Antillean forms, whereas the fauna south of the Crooked Island Passage is composed of a complex of well-differentiated species, several with their own subspecies confined to these islands and island groups. The southern fauna is also composed of several forms whose ultimate origin is difficult to ascertain (insofar as close relatives on the Greater Antilles are concerned).

This last statement should not be lightly construed. Its significance is obvious. Such peculiar southern forms as *Leptotyphlops columbi, Leiocephalus greenwayi, Tropidophis greenwayi,* and *Sphaerodactylus corticola,* for example, are so different from both their Greater Antillean and Great Bahama Bank congeners that their degree of differentiation makes postulation of their ultimate origin and relationships extremely uncertain. Although not all the southern Bahamian fauna is so distinctive, the very high number of forms that are specifically differ-

[1]Hecht (1951:24) regarded *A. barbouri* as a subspecies of the Hispaniolan and Navassan *A. cochranae*. Although these two species comprise the subgenus *Aristelligella,* I do not consider them conspecific and, pending further study, regard *A. barbouri* as an Inaguan derivative, specifically distinct from *A. cochranae*.

[2]See Note 3, Appendix.

ent from their Greater Antillean relatives stands in strong contrast to that of the Great Bank fauna.

Once the basic differences between these two faunas are recognized, it is possible to catalogue the animals according to the islands or banks where they have evolved. The primal endemic Crooked Island Bank fauna is composed of *S. corticola, A. brunneus,* and *L. punctatus,* that of Great Inagua of *A. barbouri, S. inaguae, L. inaguae, A. maynardi, Ch. malonei,* that of the Caicos and Turks banks of *Aristelliger* sp., *S. underwoodi, A. scriptus, C. carinata, L. arenarius, E. chrysogaster,* and *T. greenwayi.* Rum Cay and San Salvador have the endemic *L. loxogrammus* and *Leptotyphlops columbi* but lack endemic species of anoles. On some of these islands or island groups, the extant herpetofauna is greater than these listed species. Such instances as the occurrence of *Anolis distichus* and *Anolis sagrei* on Rum and San Salvador, *Hyla septentrionalis* on Rum, San Salvador, and the Crooked Island Bank are the result of invasion of these islands and banks by species from adjacent land masses (Great Bank or Hispaniola) relatively recently.

If it seems that too few species are regarded as primally endemic to some of these islands or banks, Mayaguana today serves to reinforce the example of a paucity of forms on some Bahamian islands. Mayaguana is about 28 miles (45 km.) long and 7 miles (11 km.) wide—thus an island of some size—which lies on its own bank more or less between the Crooked Island Bank to the northwest and the Caicos Bank to the southeast. The Mayaguana fauna comprises but two species—*Anolis scriptus* (which has arrived there from the southeast) and *Sphaerodactylus mariguanae* (which I regard as endemic). *Cyclura carinata,* another southeastern species, occurs on Booby Cay off the eastern tip of Mayaguana but is unknown from the main island. Thus, an island lying between two banks, each with its own endemic faunas, has three species, of which one (*Sphaerodactylus*) can be regarded as having evolved there. It seems that the primal endemic herpetofauna of Great Inagua is commensurate in number of species and endemicity with that of the other southeastern Bahamas, considering Inagua's larger size and its geographic position and proximity to Hispaniola with its own complex fauna.

Considering the rather striking differences between the two basic Bahamian faunas, it seems evident that we are dealing with two groups of animals. One (south of the Crooked Island Passage, including San Salvador and Rum Cay) is an old group, long in residence,

which has diverged strongly from its more southern Greater Antillean relatives. The other (Little and Great banks) has a fauna that is much more recent (Pleistocene or post-Pleistocene), which has diverged but little in most cases from its Greater Antillean relatives. (The species in these categories are listed in Tables 1 and 2). These differences suggest that these two major groups of islands have had independent histories, and that submergence of the islands south of the Crooked Island Passage during the Pliocene and Pleistocene was far from complete. I reject the hypothesis that the distinct fauna of the southern islands has evolved synchronously in a parallel fashion with that of the northern Bahamas since Pleistocene emergence. Although evolutionary rates may vary, it seems hardly likely that *Leiocephalus carinatus,* for instance, on the Great and Little banks should have evolved into a series of (relatively weakly differentiated) subspecies while on the southern Bahamas, *L. schreibersi* has given rise to two very distinct species (*inaguae* and *arenarius*), *L. raviceps* has evolved *L. loxogrammus,* and *L. punctatus* and *L. greenwayi* have originated from *L. carinatus.* These examples can be multiplied, but it seems unnecessary. The differences between the faunas of these two regions are so striking that it seems obvious that we are dealing here with two distinct faunas, one of which is old and the other relatively recent.

Supplementary comments on two species are necessary. Although *Leiocephalus punctatus* was long considered a subspecies of *L. carinatus,* recently Etheridge (1966:88) expressed the opinion that it is specifically distinct, and I concur with this assessment. Secondly, *Anolis brunneus,* although clearly a *carolinensis*-like anole, differs so strongly from *A. carolinensis* on the Great Bank and the North American continent, as well as from its Cuban subspecies (*A. c. porcatus* Gray) that I have no hesitancy in regarding it also as a full species rather than a subspecies of *A. carolinensis.* Both *L. punctatus* and *A. brunneus* are restricted to the Crooked Island Bank and affiliates. I do not regard either of them as direct derivatives of their relatives on the Great Bank. Rather, I consider them remnants of a former Bahamian fauna which has been able to persist only on islands south of the Crooked Island Passage. Both species may have differentiated there, or they may represent relict populations of species, formerly widespread to the north and east, which were eradicated by extensive Pliocene-Pleistocene flooding over the area now occupied by the Great Bank. Conceivably such remote forms as *Leptotyphlops columbi,*

Leiocephalus greenwayi, and *L. loxogrammus* are also remnants of this former Great Bank fauna.

There remain for discussion the five forms mentioned above, occuring on the Little and Great banks today, which have diverged to a degree regarded as specific by most workers. These include the boids *Epicrates exsul* and *Tropidophis canus,* the colubrid *Alsophis vudii,* a turtle (*Chrysemys felis*), and the ground iguanas (*Cyclura*). The *Alsophis, Tropidophis,* and *Cyclura* all have non-Great Bank subspecies, but I do not feel that they are basic inhabitants of non-Great Bank areas. The non-Great Bank races of the *Alsophis* and *Tropidophis,* for instance, are disjunct in the southern islands, and the *Cyclura* (represented on the Crooked Island Bank and San Salvador) seem to show a basic Great Bank radiation with "overflow" onto two adjacent areas. It is difficult to interpret these five "species" in any way other than that they represent another fragment of a former great Bank fauna which has persisted somewhere in the area now occupied by the Great and Little banks, and, with re-establishment of these banks in their more recent configuration, that some of them have been able to expand their distributions once more throughout most of the Great

TABLE 1

I. Old "Great Bank" fauna

Cyclura sp.	*Alsophis vudii*
Epicrates exsul	*Chrysemys felis*
Tropidophis canus	

II. New "Great Bank" fauna

Hyla septentrionalis (C)	*Anolis distichus* (H)
Eleutherodactylus planirostris (C)	*Anolis sagrei* (C)
Sphaerodactylus decoratus (C)	*Leiocephalus carinatus* (C)
Sphaerodactylus notatus (C)	*Ameiva auberi* (C)
Tarentola americana (C)	*Typhlops biminiensis* (C)
Anolis angusticeps (C)	*Typhlops lumbricalis* (C)
Anolis carolinensis (C)	*Epicrates angulifer* (C?, H?)

I. Five species of Bahamian reptiles, occuring today primarily on the Great and Little Bahama Banks, that are remnants of a previously widespread Bahamian fauna. II. Fourteen species of amphibians and reptiles, today primarily restricted to the Little and Great Bahama banks, that have differentiated little or not at all from their Greater Antillean relatives. Presumed source of Bahamian populations indicated by C (Cuba) or H (Hispaniola).

Bank area. The exception is *Epicrates exsul,* which is known to occur only on Great Abaco on the Little Bank.

What geologic evidence is there to indicate that those islands now comprising the Little and Great Banks have had a history different from that of those islands south of the Crooked Island Passage? Schuchert (1935) discussed the history of the Bahamas in detail. He stated that the Bahamas as a group have had a bipartite history, the area now occupied by the Little and Great Banks being considered as a foreland of Cuba (and geologically related to that island) and a southern volcanic arc (p. 534). The latter is composed of "the series of flat-topped 'Bahama mountains' in the southeastern part of the archipelago" which are "plainly volcanoes surrounded by depths of

TABLE 2

I. Primal southeastern fauna

Aristelliger barbouri
Aristelliger sp.
Sphaerodactylus caicosensis
Sphaerodactylus corticola
Sphaerodactylus inaguae
Sphaerodactylus underwoodi
Sphaerodactylus mariguanae
Anolis brunneus
Anolis scriptus
Cyclura carinata
Leiocephalus greenwayi
Leiocephalus inaguae
Leiocephalus loxogrammus
Leiocephalus punctatus
Leiocephalus arenarius
Ameiva maynardi
Leptotyphlops columbi
Epicrates chrysogaster
Tropidophis greenwayi
Chrysemys malonei

II. Recent southern invaders

Hyla septentrionalis (GB)
Eleutherodactylus planirostris (GB)
Sphaerodactylus decoratus (GB)
Anolis distichus (GB)
Anolis sagrei (GB)
Cyclura sp. (GB)
Mabuya mabouya (H?)
Typhlops biminiensis (GB, C?)
Epicrates angulifer (GB, H?)
Tropidophis canus (GB)
Alsophis vudii (GB)

I. Twenty species of reptiles comprising the primal herpetofauna of the southeastern Bahamas (south of the Crooked Island Passage and including Rum Cay and San Salvador). These species as a group differ strongly from both their Hispaniolan or Cuban congeners as well as from their Great Bank relatives.

II. Eleven species of amphibians and reptiles that are recent arrivals, primarily from the Great Bahama Bank (GB) or possibly from Cuba (C) or Hispaniola (H), on the islands south of the Crooked Island Passage, including Rum Cay and San Salvador.

water ranging from 6000 to 12,000 feet. Such are San Salvador. . . . Rum Cay, Mariguana, Great Inagua, Caicos Island and banks, Turks Island" plus Cat Island and the Mouchoir, Silver, and Navidad banks. None of the latter three banks now has any land areas, but Rand (1962:2 and 3) has commented on the type locality of *Anolis scriptus*, a species which may have been collected on the Silver Bank in the late 1800's.

It is remarkable that it is those very islands mentioned by Schuchert that have such a distinctive herpetofauna today. This seems hardly due to chance. Grossly the islands south of the Crooked Island Passage in no way resemble either the recent volcanic islands of the Lesser Antilles or the more ancient volcanic islands of the Virgins, since they have been "modified by ash, subaerial detritus, and organic marine accumulations". (Schuchert, 1935:535). As to time of southeastern Bahamian volcanism, Schuchert (1935:536) considered that molten flow ceased before the close of the Middle Eocene, but that there may have been some renewal of volcanic activity as recently as Late Miocene-Pliocene time. There are insufficient data to pursue this line of thought further. It does seem established that the islands south of the Crooked Island Passage—precisely those islands that have a fauna distinct from that of the Little-Great banks—have had a geologic history different from that of the balance of the Bahamas.

Among the islands noted by Schuchert as being volcanic in origin is Cat Island. Although I have not distinguished Cat from the balance of the Great Bahama Bank in all the preceding discussions, it merits special attention. It lies on its own bank (along with Little San Salvador) and is one of the highest [205 feet (61 meters)] of the Bahama Islands. In height it is exceeded only by volcanic San Salvador with an elevation of 240 feet (73 meters). Rabb and Hayden (1957:5), quoting from Lee (1951), stated that the Bahamian volcanic arc included Eleuthera and extended north to the Abaco region. Thus, to Cat Island, which lies beyond the seaward edge of the Great Bahama Bank, may be added both Eleuthera (which forms the northeasternmost edge of the Great Bank) and Great Abaco (which forms the easternmost edge of the Little Bank). The volcanism of these islands achieves more than merely academic importance, since both Cat and Eleuthera are inhabited by *Chrysemys felis* (the only islands whence the species is known) and Great Abaco is the only island inhabited by *Epicrates exsul*. Although the facts of volcanism and persistence of the old "Great Bank" fauna may not necessarily be correlated, it does

indeed seem more than coincidental that two of the five old "Great Bank" reptiles are to be found today on this northeastern series of volcanic islands. It seems likely that Cat, Eleuthera, and Great Abaco have had still different histories than those of the balance of the Little and Great bank islands. Although there is no evidence that it has been the case, it is tempting also to consider that Cat and Eleuthera have been the haven for the three remaining old "Great Bank" reptiles as well. At least *Alsophis* and *Tropidophis* occur today on these islands, whereas *Cyclura* does not.

In summary, I suggest the following sequence of events in the herpetological colonization and differentiation in the Bahamas:

I. Invasion of the old "Great Bank" area by a primal fauna from the Greater Antilles—presumably mainly from Cuba but possibly partially from Hispaniola.

II. More or less synchronous invasion of the southeastern Bahamas primarily from Hispaniola.

III. Extension of the primal "Great Bank" herpetofauna to outlying islands (San Salvador, Rum, Crooked Island Bank) by some old "Great Bank" species (*L. punctatus, A. brunneus, L. columbi*) where these latter persisted.

IV. Extinction of most of the old "Great Bank" fauna by inundation while the southeastern fauna persisted *in situ* and some old "Great Bank" species persisted in specialized refugia (Cat, Eleuthera, Great Abaco) in the Great Bank area or on outliers within the southeastern area (San Salvador, Rum, Crooked Island Bank).

V. Re-emergence of the Great and Little banks with subsequent re-invasion by species from Cuba and Hispaniola which persist today in forms that are not, or little, differentiated from their Cuban or Hispaniolan relatives; synchronous expansion of old "Great Bank" species onto newly available land from old refugia.

VI. Re-invasion of the southeastern Bahamas by a few of the new Great Bank Species.

APPENDIX

1. Although Garman, in consideration of the masculine gender of the Greek noun *dactylos,* modified the Latin suffix *-icola to -icolus* to agree in gender with *Sphaerodactylus,* there is no classical precedent for this change, nor is it correct. The basic Latin noun involved (*incola,* meaning "inhabitant; dweller in any place") is of common gender. Thus, despite the apparently feminine first declension terminal *a, incola* refers to inhabitants or dwellers of either sex. When *incola* is combined as a suffix with other Latin nouns (*ager, silva, rus, mons*) to form compound classical nouns denoting an inhabitant of some particular situation (*agricola, silvicola, ruricola, monticola*), these derived compound nouns either retain their original common gender, or in one case (*agricola*) are either common or masculine. In the latter instance *agricola,* aside from meaning "inhabitant of the field" has a secondary meaning of "farmer," a distinctly masculine occupation. Neo-Latin substantive nouns used in systematics (*cavernicola, rupicola, nubicola, deserticola, limnicola, petricola,* etc., etc,) are non-classical in origin, but classical in formation. By analogy, such neo-Latin nouns are to adhere to the classical pattern and gender and are to retain the terminal (apparently feminine but actually of common or masculine gender) *a* without modification. Since the suffix *-icola* is already of common gender, it is incorrect to modify it to *-icolus* in an attempt to make it agree with a masculine generic name. It should also be noted that words ending in *-icola* are nouns, *not* adjectives, and thus, when used in nomenclature as trivial or subspecific names, are in apposition with the generic name, not adjectival modifiers of it.

2. Williams (1956:157) suggested that the two Bahamian *Pseudemys* (=*Chrysemys*) "may be neither native nor recognizable," and he may well be correct. However, I have collected both forms and am impressed with the differences both between them, and between them and *Chrysemys decussata,* whence they most logically might have originated through natural means or through human introduction. I therefore prefer herein to consider them both native and distinguishable, although further detailed study of *Ch. felis, Ch. malonei,* and *Ch. decussata* might well convince me otherwise. If the two Bahamian "species" can be shown to have been artificially introduced, obviously my comments about their origin and history in the Bahamas are invalid. If on the other hand they are found to be native, whether recognizable species or subspecies or not, it should change my interpretation of the history of the Bahamian herpetofauna but little.

3. As recently as the visit by Schwartz and Leber to Great Inagua (1960), there were no frogs on that island. Noble and Klingel (1932), reporting on Klingel's three months' stay on Inagua, made no mention of any amphibian occurring there. In 1960, Sammy Nixon, a local Inaguan, commented to me that he had seen one frog on Inagua. It had arrived there in a load of lumber and had been quite a source of interest to residents to whom frogs were completely unknown locally. It is appropriate to state that frogs did not occur naturally on Great Inagua. The situation has changed somewhat, however. Edward Godet, a resident of Matthew Town, told me in June 1966 that he had occasionally seen small brown frogs (*? Eleutherodactylus planirostris*) in that settlement but that they were not common there. In February 1967, Richard Thomas heard scattered calling male *H. septentrionalis* in Matthew Town but secured no specimens. Mr. Nixon advised

Thomas that frogs (presumably *H. septentrionalis*) were for a time abundant about the remains of a recently crashed private plane and that they had gradually reached Matthew Town. Another rumor is that the frogs arrived at Inagua in banana shipments from Long Island and that for a time they were abundant only about the airport but have now reached Matthew Town. In any event, *H. septentrionalis* now occurs on Great Inagua. Whether its arrival there has been from the continent (Miami) or from elsewhere in the Bahamas is unknown. The occurrence of *E. planirostris* has not been confirmed, but it is a likely candidate for overseas transport.

4. Neill (1964, Quart. Jour. Florida Acad. Sci., 27(2):127) reported the occurrence of *Rana grylio* Stejneger as a deliberately introduced species on New Providence. Wayne King has advised me that *R. grylio* occurs (presumably also as a deliberate human introduction) on Andros. I have collected the species on New Providence and have seen many young frogs in the mangrove swamps south of Fresh Creek on Andros, but did not secure specimens. Dr. King's identification is based upon material in the collection of the Florida State Museum. Since *R. grylio* has obviously reached the Bahamas through human agency, it does not comprise part of the native fauna and is not mentioned further. For the sake of completeness its Bahamian range is recorded here.

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